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THE REAL CURRENCY OF COMMERCE.

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HAVING been invited to contribute a paper to the series of admirable articles on the financial problem which have appeared in THE ENGINEERING MAGAZINE, it gives me pleasure to comply; but, in order to do so, present demands upon my time make it necessary to draw largely upon an address which I had the honor of delivering before the Bankers' Convention, at New Orleans, in the fall of 1891.

To those of my readers who are confused as to the nature and functions of real money, and who are fearful of the supremacy of gold, I would most strongly commend the two excellent articles upon the subject which have lately appeared in these pages,—namely, "The Unit of Value in All Trade," by Mr. Edward Atkinson, in August, and "A Scientific Analysis of Money," by Mr. Emil Schalk, in September. These gentlemen have given us such a lucid exposition of the conditions and reasons which make gold the one universal standard of all values that I am at a loss to see how any one, after reading them, can be longer confused upon the subject. And it is because they have thus made clear the essential characteristics of real money that I shall now confine myself to a consideration of the currency—paper money—with which we transact the business of each day.

Although money is the measure and numerator of value in every other form of property passing between men, it is itself actually present in but a small proportion of the interchanges that constitute the great movements of trade and commerce; and it becomes less

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and less relatively used as civilization advances. What is called buying and selling is to the greatest extent, not the purchase of things for actual money, but simply an exchange or barter of the money's worth of one thing for the money's worth of another thing, by means of paper instruments called *currency*. In whatever variety of method such instruments are used, they do not, like money itself, possess inherent value of their own, but they derive their entire power and significance from the property which they convey. In every transaction to which such papers refer, they declare in effect that they are not the money, but only the shadow of it, and that the substantial value each piece represents is somewhere else concurrently moving with it in the process of exchange, or going forward to market. For example, the interchange of goods and merchandise, passing between people in the United States, amounts to more than three hundred millions per day. Only about one-twentieth part of this is done by the presence or manipulation of money. Nineteen-twentieths consist of an exchange or barter of that amount of one kind of property for the same amount of another kind, in the endless variety of things put in motion by the necessities of social life, and transferred by instruments in writing or printing, upon valueless pieces of paper, giving evidence of each transaction, in terms of money. And the same is measurably true in the commerce of the whole world. Stripped of the mystery and ambiguity that hang around them, the paper instruments by which all this is effected are currency, because they make industrial products current in the channels of commerce. In whatever form used, they are nothing more than written orders from one owner of a commodity to deliver the same to another owner.

A bill of exchange is the typical currency of the world. It is an instrument that exchanges moving property. It does not say that money itself, but something of the money value named in it, is passing from man to man by its instrumentality. In every movement from its origin to its end, it carries vital things,—goods, wares, or merchandise. If not, it is false to its name and nature, has left a vacuum to be filled, and done that amount of damage to commerce, yet to be repaired.

Paper documents thus conveying property have various names and applications. None of them are money, any more than a deed of a house is the house itself; yet they all perform the same substantial office,—viz., that of promoting a convenient interchange of various products of industry, through the channels of trade and

commerce. Bills of exchange, bills of lading, bank-checks, bank-notes, or certificates of deposit, and even telegraphic transfers, are all similarly used in conveying existing things from owner to owner. And if legitimately issued, the relative property can be found by search,—just as truly as real estate can be found through its deeds of conveyance,—to be actually existing, each article responsive to its respective piece of paper record. Otherwise the document so used is commercially a false one, and, by whatsoever authority emitted, it can only enter into the commercial exchanges to vitiate to that extent the entire volume. Loaded ships passing each other upon the ocean, with cargoes of reciprocal values; railroad cars filled with merchandise, threading their way to and fro through the land; vehicles of every kind, crowding along the streets of cities, towns, and villages; toilers on foot or in fields, manufactories, and shops,—all who labor in any useful way expend and renew their native vitality by exchanging its results one with another, upon conditions measured and expressed upon such paper documents in terms of money; while the money itself constitutes less than a tenth part of the aggregate sum of commodities or service so passing between them. The world has thus ever been alive with these movements of industry and toil. They belong to men as personal and responsible beings, independently of all governments. As government has no attribute or function whatever for productive labor, but is dependent for its very existence upon the labor of its people, neither can it legitimately furnish instruments that only rightly follow *after* production. Governments can directly draw from the real producers by taxation such portion of the fruits of their labor as can be spared for the national administration and protection; but any attempt to forcibly impose its own paper instruments upon commerce, in advance of industrial productions of the country or without their accompanying supports, not only transcends all its legitimate powers and impairs the equitable relations of citizens with each other, but can only end in destroying the sources of its own vitality. There is no place in sound financial economy where a government, any more than a private citizen, can, with impunity, introduce into commerce a single item of paper currency not supported by its equivalent value of existing commodities, passing with and pledged to redeem it.

What is a bank but a depository, not so much of money, as of the money's worth of the variety of articles that its dealers are producing and interchanging through them, hour by hour? Their

deposits, what are they? Not money, but so much money's worth of existing commodities continually changing and moving about in kaleidoscopic variety from one form, from one person, and from one bank to another? Every deposit brings to the bank some new commodity, and every check releases some one previously held. Their capital, what is it but a vested interest in the same convertible mass of stored industry? Their circulating notes, what are they, when properly issued, but more minute representations of the same substantial and exchangeable results of human service? And their bills receivable, they are nothing more nor less than chattel mortgages upon goods held in custody for them by their customers, who have promised in writing to surrender so much of their value as they have previously received. Each one and all of these functions of a bank are simply commercial expedients to facilitate the division and distribution of the miscellaneous productions of human labor. And the daily exchanges of checks between banks at the clearing-house? What are they but evidences of the industrial movements of the whole city the day before? Each check pointing to a box, bale, or bundle containing the commodity that gave it birth, and attesting the fact that by it some real thing, of the money value named, has passed from owner to owner, and from bank to bank, the validity of which is proved by the payment in actual money of balances resulting from the exchange of such checks. All these are but various ways of exchanging existing things, and are valid and admissible only to the degree that they are resolvable into other things of daily necessity.

The whole movement is one of property, not of money.

In fact the safest bank officers are those who keep the papers and the property most persistently together, and who hold them in the closest relation to each other.

International trade of the world is carried on from age to age in substantially the manner here described, by bills of lading and of exchange, conveying from port to port, and from citizen to citizen, the productions of the industry of their respective countries. These are divided and sub-divided through banks and bankers in New York, London, or elsewhere, as the interest and convenience of commerce require, and the desired result is reached by exactly the same natural methods of distribution. Commerce is but an exchange of material things. The instruments it uses are born in the things to be moved, and cannot be dissevered without impairing the utility of the entire system. "Their lines have gone

out through all the earth, and their words to the ends of the world."

No government device or debt currency has ever been or can ever be, without intrusion, admitted into the international exchanges, and no want of it is ever felt. On the contrary, its introduction would be instinctively repelled by merchants and other governments the world over, as an invasion of natural rights, utterly discordant with legitimate trade, and adverse to every commercial interest. What is confessedly false in the commerce of the world at large must be equally so when applied to any one of its nationalities, or to the individuals composing it. Human law cannot change the essential nature of things.

As all valid currency is thus invariably found directly springing out of useful labor, so the want of it can only be supplied by more rigid economy in expenditures and by renewed effort in production. Thus only will it be produced in manner and measure to meet every social and commercial requirement, from the smallest trade to the largest commerce. It is not national currency that is wanted, but things to be exchanged. These can be produced only by human effort. Currency is a consequence, and will come of itself when the object of it exists. Any extrinsic emission which multiplies baseless instruments of expenditures can only serve to promote extravagance, by deceiving the public as to its real ability to expend, and thereby to repress all effective efforts at restoration.

Two important lessons may here be learned :

First. That no just estimate of the amount of currency required by a community can ever be made in advance of the industrial work done ; because the currency will naturally follow the product and provide means for its own distribution and conveyance, if government do not interpose its overwhelming power by injecting into it an abnormal and baseless issue, or by prohibiting the use of such instruments of transfer as commerce naturally creates for itself. That any calculation predicated upon a *per capita* ratio of currency to population is essentially and manifestly absurd, because, not the wishes, the poverty, or the number of people, but their productive industry alone, can determine what instruments of exchange are required, and who has the right to issue them.

Second. That currency derived from natural causes will come and go, and live and die, in exact coincidence with the volume of useful things to be moved by it, and will therefore, possess the quality of elasticity which attaches only to the genuine article, and

which can never characterize a superimposed emission. This is the striking defect of our existing currency. It comes from an extrinsic source, not in response to commercial demand, and will not retire when its special service is performed. Immediately upon its emission, it becomes inseparably absorbed in the previously existing volume and there remains, irrespective of times and seasons and of commercial necessity. From first to last it is a debt, without corresponding assets in store waiting to redeem it; an outside and disturbing element, without homogeneous relations to the trade it is meant to promote. Its constant tendency is to create and to maintain fictitious prices, and thus to counteract the harmonious precision that the movements of commerce naturally make for themselves. A credit currency without full and convertible security can never give substantial relief. It will always be insufficient to meet the demand, because it inflates in expectation of further issues, and, when these are once entered upon, the solid commercial principle is thereby avowedly relinquished and the stability of prices is consequently destroyed.

For illustration, follow for a moment the movement of a single staple crop. How could that be best carried from harvest to market? Those who take it from the ground have in hand the vital thing that the world requires. At the very start, the producers desire to subdivide it in such manner that it will itself furnish means to pay for the labor and expenses of gathering the harvest. This they should be able to do by pledging the crop to responsible persons competent to accept it, who could immediately issue against it, at the place of departure, an approximate amount of circulating notes, evidences of possession, with means of redemption. These would be local currency, receivable throughout that community, at their money's worth, for such other things as the holder and laborers found necessary to purchase. The crop would then be transported toward the sea, either for consumption or for re-shipment, by means of larger bills of exchange, and the proceeds of it carried back, either in money or in other commodities, to the place of departure. These would there be distributed through the ordinary avenues of local trade, and be paid for in the currency first issued, which meanwhile would have served its purpose for local expenditures and been returned to its issuers for payment.

So the circle of exchanges would have been completed, the crop have done its good work in the world, and both the larger and the smaller instruments by which it was accomplished all retired from

service. This service, so essential and so beneficent, has in the past been thus naturally done, year after year. It was freely relinquished when demanded by the supposed necessities for civil war, because the life of the government itself was at stake, and because commercial laws were necessarily subservient to the preservation of the nation. In the agony of the civil conflict, and when legal tender notes without security had been issued to the utmost practicable extent, Secretary Chase conceived the idea of replenishing the exhausted treasury by further sales of government bonds, giving banks specially organized under a law "*to provide a national currency*" the *exclusive* privilege of issuing currency notes based upon interest-bearing bonds of the government as security at 90 per cent., and prohibiting every form of circulating notes in the country by a penalty of *10 per cent.* upon any note otherwise emitted. But the impression now unconsciously prevails that what was then *precipitately done as a temporary expedient* was the result of deliberate and unconstrained legislation; and that, therefore, every form of local currency has been finally and forever superseded. This conclusion cannot be reached without ignoring both our own experience and the experience of men throughout the civilized world, nor without inestimable loss to commerce and to the nation. With equal reason may bills of exchange of larger denominations, by which whole crops are carried to market, be prohibited, as the smaller and no less useful ones, by which they are first gathered in, sub-divided, and started upon their course. By this prohibition of currency the annual commercial movement is obstructed at the vital point of departure. This fact is emphatically expressed by the cry periodically and vainly made for "currency to move the crop," when the crop contains the inherent power to move itself; a power which cannot be used because this legal restriction continues in force. So that as often as the harvest season comes around, it is found that government currency is so fully absorbed in the general circulating medium that it cannot be released and gathered up to meet this indispensable local requirement, without producing such financial embarrassment as retards the very movements of the crops themselves. A practical difficulty consists of the doubt whether any form of local or corporate indebtedness, like government bonds, can always command absolute sale in the markets of the world. And so the conflict between universal commerce and local currency annually finds repeated demonstration and expression in our own experience and observation, from the want of elasticity and

itself has in no respect lost its practical importance. On the contrary, to maintain commercial order and integrity, it can neither be dispensed with nor degraded from its supreme rank and importance by any local devices or substitutes, without infinite peril. Its universality, utility, and uniform character must not only be persistently maintained by every commercial people, but enough of it must be always held at command to meet and justify the claim for value of commodities passing through their commercial exchanges. Money must be ever ready to present itself as the only alternative, whenever its equivalent in property is challenged. It stands forth the ultimate arbiter of all commercial questions and values. Enough of it must be available and in close alliance with current business to meet balances between peoples, places, and nations to prove the validity of their trade; to meet unexpected events and vicissitudes in public and private affairs, or any exigency impairing commercial confidence; enough in a word to assure the public that it is enough. Deprived of these high qualities and practical uses, money loses its supremacy as a measure of value, and sinks into merchandise, subject to all its fluctuations and reverses.

It is but twenty years since Germany, in re-organizing her current coins so as to give emphatic expression to the existence of a new nationality, determined to place herself upon full equality with England, who was supposed to derive some commercial benefit by alone adhering to a gold standard. This great change by a great and victorious nation overwhelmed other European powers, and constrained them one after another to close their mints to silver coinage. Silver therefore no longer commands the same unquestioned right as before to be money in international payments, and, excepting for subsidiary coins and as a local medium, it is already reduced in the western nations to the condition of a commercial commodity.

It was perfectly natural that our country, the largest producer of silver, should contend with all its might against the abandonment anywhere, and especially at home, of coined money composed of our own ancient and familiar metal. And because Congress had given vitality and money power during the war even to irredeemable paper, it was plausibly urged that it had unquestionable right to maintain the coined "dollar of the fathers" at its full original worth against all the powers of the world.

But the diminished use of silver throughout Europe had so

flexibility in the circulating medium. To some extent this want has been supplied by the increase of small national banks organized throughout the country, by which local exchanges of commodities are pivoted from one dealer to another, as in the country store, by means of deposits and checks; but they do not fully meet the commercial requirement, and the unceasing demand for currency remains to be provided. Besides all this, the "National Currency Act," the name under which United States government banks were organized, and which expressed the original object of their creation, is practically passing away by the redemption of the public debt. Something must be done to meet this imperative necessity and earnest demand.

It will certainly be found easier to legally restrict commercial instruments within the bounds of their constituent property when emitted by corporations, under the supervision of jealous government authority, than it is to restrain excessive issues by a popular government, when it has once assumed as its inherent privilege and prerogative the power to create currency without security at its own convenience, independent of all natural relations to the commercial basis and demand. If it endangers the public safety and is therefore criminal for any one man to issue a currency obligation without an equivalent asset, is it essentially less so when organized numbers clothed with delegated authority do it without reserve?

In every form of negotiable obligations their prompt redemption is the vital object to be secured. This can be best done by authority given to corporations under national authority to issue registered circulating notes based upon commercial assets, with limitations of amount proportioned to capital engaged. With these requirements and a penalty of an extra rate of interest upon notes while in default, an enforced redemption, and making the notes a preferred debt, with mutual liability of all who participate in them throughout the entire system, and a safety fund in reserve, a practical and substantial currency could be established. By these restrictions every participating member would become a vigilant guardian over the whole body, the interests of commerce would be promoted, and perfect safety assured.

No government currency can possibly be made, in the very nature of things, combining all these requisites of elasticity, commercial stability, and guarantees of public welfare.

While paper currency instruments, as we have shown, perform so large a share of the vital work in the commercial world, money

reduced its value below the ancient standard that these patriotic dollars were no longer serviceable as a money reserve for international payments; and they became even less important than a mere commodity, because the difference between their legal and their actual value prevented their being readily converted into other merchandise that would pay foreign debts through commercial interchange.

We are therefore no more masters of the situation in respect to the mineral composing money than to any other of the products of the country. The outside demand will determine the real value of them all, and to establish a local price of any thing by law can only create a vexatious impediment to its easy and equitable commercial solution.

The only rational treatment of this one commodity is to let it naturally pass into the channels of commerce and take its chances with other productions of industry, there to exert its own influence with the powers of the world who must unite with us in deciding whether it shall hereafter be an ingredient of commercial money or not.

Since silver coinage was placed upon trial for life in Europe, the amount buried in the United States government treasury has swelled by the silent operation of law to nearly $500,000,000, besides more than $100,000,000 held in personal and corporate reserves. This great and growing aggregate stands before the world a menace of vast proportions, depressing the price and retarding the metallic re-union so much desired. *What is to be done with it?*

The certificates and notes representing it are not naturally redeemed like bills of exchange, by conversion of the constituent property through the exchanges of commerce. It lies as dead and as useless as when in undiscovered mines, while *they* continually go the rounds as local currency, never themselves paid, but ceaselessly moving in current payments through the community, and increasing faster in volume than in intrinsic value. They raise the prices of property above the commercial standard, encourage expenditures, and create an adverse balance of international trade, which can be paid only in gold. This is the natural and undeviating law of such issues. Shall *this go on forever*, and *what is the inevitable result?*

LACK OF ORIGINALITY IN ARCHITECTURE.

By Russell Sturgis.

THERE has been great annoyance to the lovers of architecture from the recent instances of copying on a large scale. The mockers have mocked : but the citizens who are hoping against hope for signs of life in our fine art of building have been scandalized in the literal sense of the word. It has been a trouble to many that, in our recent American architecture, a whole building, or a large and showy member of a building, should have been so closely copied from some fine old structure in Europe that it is easy of recognition. But those who are greatly exercised about this should not need to be told that such close copying has long been the rule in details. For what purpose are used those large photographs of small details of which every architect has as many as he can afford ? Are they supposed to be for artistical stimulus only and the free converse of the modern designer's mind with the great designs of the past ? There may be some offices where this is indeed their chief use. But one need hardly fear contradiction in saying that in the majority of cases they are used for simple copying. Either the photograph is handed to the draughtsman with instructions to rearrange the scrolls—a Renaissance panel of scroll-work being assumed—so that that design which was made for a surface twice as broad as high will fit one a little more nearly square ; or to alter the leafage around the cartouche—a Louis XV. pier-ornament being assumed—so that they will not cost so much to cut ; or to make the capital thicker at the neck-molding—a Gothic column being assumed—so that it will better fit the modern Romanesque style of the porch ; either this, or else the photograph is simply handed to the stone-carver with orders to carve two like that and two differing slightly, so ! and so !

Mr. Hamerton says of the French nobles before the revolution that the compulsory and unpaid labor of the peasants was regarded by them as a natural force to be made the most of, like wind or a stream of water. Ericsson's invention of the screw-propeller and Whitney's cotton-gin were simply appropriated by the public without reward to the inventors. In like manner, the fine decorative work of our predecessors in the artistic life is considered common

property. No man need be ashamed or need hesitate to make the carvings and the inlayings and the paintings of the past his own so far as their spirit and their individuality is concerned. It is not many days since one of the more artistic, and also one of the most successful of the younger New York architects, hearing the complaints of a more naïf critic in a case of very visible "conveying," said very naturally and simply that he thought that none of the architects now expected to get up new designs for ornament; that all simply took what they wanted. It is not many months since one of our leading artists in decoration, setting his draughtsman to copying, not photographs, but the simple, cheap, and widely-known prints of *Art pour Tous*, said, half to himself, that there was nothing new under the sun; the inference being that he thought it better to do his taking openly than to make believe invent.

It is not asserted here that this habit is quite so universal as the architect cited above seemed to think. It is not asserted that there is any moral wrong done. What is asserted is that there has been for many years a deliberate taking of ancient details of all sorts and a fitting of them into modern buildings with greater or less skill; and that no one ought to be surprised at the growth of the habit into the taking of whole towers, whole gable-ends, whole edifices. In fact there is surprise in this case merely because few persons know the carved, the inlaid, and the painted ornaments, while many know the general aspect of a famous old building in a famous European city.

"But, morally wrong or not, artistically this is a very dreadful state of things! What is the remedy?" There is no remedy. The architects will give their clients what their clients will consent to receive. Their clients ask for a certain spirit, a certain comeliness, a certain approach to beauty in the resulting structure, but what client ever asked for originality? The architects will give their clients what their clients will consent to receive, because architects are not artists in the usual sense, but professional advisers; because the business of the architect is grown to be a great fiduciary, money-spending, administering profession, liberally paid, as all money-spending and administering professions will always be. A painter, even a painter who loves money and lives with rich people, will not, knowingly, sacrifice his pictures to his purse. If he does, his fall is rapid, and his place as an artist knows him no more. A painter's art is much to him, is almost everything to

him, even if it is but a poor little staggering art that he is master of. But an architect need not have any such devotion to any form or fashion of fine art. An architect is employed to spend, judiciously and wisely, perhaps a million dollars a year of other people's money in the erection of important and permanent structures; skilfully planned, carefully built, money-making structures. In doing this he earns a very handsome income; and this he earns, not as an artist, but as an organizer and director of labor, and the payer-out of large sums of money. If he is an artist, or if he cares to use the services of artists, that is secondary. If he thinks his employers, generally, want something artistic, or that he will be more largely employed by offering something artistic, well and good! He will give his clients what they will consent to receive. But this fact must never be lost sight of,—that it is a terrible expense to him to have to furnish something artistic; and that to select it ready made, if it is positively called for, is the simplest and easiest way, and saves him very heavy outlay.

For what is it that determines an architect's compensation? The amount of the money expended on the building. And what is it that makes up the greater part of an architect's expenses, and determines the outgoes which must be subtracted from the income? The employment of high-paid draughtsmen. And what is the most precious and the rarest commodity of all in a busy office? The architect's own time. Now then! to allow a good draughtsman, earning seven dollars a day, to spend a week elaborating a fine original design for a panel, which design will not be any better abstractly, as a separate work of art, than one of which a good photograph is at hand,—to allow such extravagance as that would be a poor sort of "business." Still less would it be business-like for the pressed and busy architect himself to spend his time over the design; indeed, he could never do it; the man who has to meet employers and contractors all day, and fly off on a superintending trip, by rail, before night, and dine *en route*, or in strange hotels on his arrival, is not in the mood of mind to be a fine designer. Designing requires a calm and receptive mind, neither fatigued nor asleep for want of occupation; designing requires some consecutiveness of thought and must not be broken in upon every few moments. Designing of ornament for a building requires a large knowledge of the building, its requirements, its possibilities, of what it is to be as a whole; and therefore the designer must be well up the ladder, a high-paid and confidential

assistant, if not the chief himself. But designing done according to all these principles, and up to the mark of fitness, of merit, and of originality, will not pay. How should it pay? The architect's commission will not be increased one dollar by all the beauty and novelty presumable in his original design. If his panel costs more to carve than the conveyed one would have cost, he will get a larger commission by that fact, but he will disaffect his client. If his panel costs less? Well, if he must make a panel to cost less, and by so doing cut his commission down; if this cannot be avoided,—let him at least not take the trouble of making a new design under such untoward circumstances as these!

These considerations apply especially to decorative sculpture and other ornamental detail, but there is a way in which they apply as well to the general design of buildings. Let it be clearly understood that time must not be spent, unduly, upon the plans, and the whole situation explains itself. Here is a set of drawings under way; considerations arise which seem to call for several days' careful thought over possible modifications, and a week's work in altering the drawings,—the five or six ground-plans, the four elevations, the two sections, the two or three partial sections, the diagrams of flues and of drainage. But a week's extra work on the drawings means perhaps two hundred dollars sunk in the pay-roll alone. But three days' careful thought on the part of the chief himself means something that he can't possibly give just now! If the stairways and halls must be changed, let the draughtsman in charge of the job alter the plans as best he can, but at all events avoid any changes in the exterior! And the chief, who alone has been instructed by the owner as to the new requirements, it may be, having given his orders to his assistant, flies out of town by the fast train, busily annotating a specification as the train bears him onward, or even laying out the plan of some newly proposed structure. The result is, even in costly, elegant, and much admired buildings, a mass of anomalies: dark halls which might have had window light if thought had been given to them; stairs of undue steepness; halls with insufficient access and exit; and, most of all, a lack of thoughtful designing in the interiors such as must be experienced and carefully noted in many buildings before the extent and generality of the evil can be appreciated. This, indeed, is the crying fault of our late nineteenth century buildings,—a lack of any intelligent artistical treatment within. The façade may be elaborated, but, once past the entrance doorway, and all signs of care vanish

together, and it appears that only the most elementary planning has been given to the rooms and corridors, stairs and lobbies. The owner and employer helps toward this neglect because he fancies that he understands the plans, and, having once approved them, thinks of them no more. But not one employer in a hundred, be it a committee, or be he a bank president or a family man proposing a family house, really understands the plans. That the fireplace is to be in such a wall, the windows facing in such a direction and the door to the hall in such a corner he knows, but what will be the effect, in convenience or in architectural comeliness, of these dispositions he does not know at all. So, while he prides himself on the minuteness of his directions and the thoroughness of his supervision in even the smallest details, the large considerations of the organization and harmony of his interior pass him, almost wholly unthought of. The owner cannot see the future structure; it is the architect who must see it if it is to come into existence as it is wanted, and he seldom has the time to see it clearly, or to look at it in his mind's eye, long enough to recognize all its features.

Originality of design is more easily got for the general masses than for the details, because the necessary accommodations of the house positively command an outline and a grouping which cannot be taken ready-made from an ancient structure. But this originality is not especially tempting to the designer himself or to the spectator: not to the designer himself, because he does not and thinks he cannot take time enough to work his design out into harmony and completeness; not to the looker-on, who finds the new structure odd enough, and novel enough, but noways charming. And therefore, when the chance offers of taking an ancient and beautiful building and copying it; when that *can* be done,—the architect may well feel a certain relief in the beautiful, thoughtful, purposeful work which his draughtsmen are copying, and the student of the finished building may well be pleased and soothed,—until somebody tells him that this is a copy, and then he complains aloud.

Originality in architectural design is not for him who seeks it eagerly for its own sake; it is for him who considers his problem patiently, for days or for moments only, until the right inspiration comes to him. Neither the faithful following of a well-known style nor the rejection and disregard of all established styles can help very much in the search for originality: nor yet can either such acceptance or such rejection seriously hinder. A designer may be

tied down to a style as closely as was Burges at Cardiff Castle, or Viollet-le-Duc at Pierrefonds,—tied hand and foot to tradition,—and yet may be original. A designer may disregard all known styles of architecture as freely as he who builds a log-cabin in the woods, and yet may show an absence of all power of original design. And the lack of originality visible in our American work of these latter days is not caused by the absence of any accepted style in which all may work, though to have one would help us: it is not caused by any unusual rarity of the artistical gift, there is a great deal of that, running to waste: it comes simply of want of thought. It does not pay to give time and thought; it does not hurt the architect much *not* to give time and thought, that is, to his design; and therefore thought is not given, time is not allowed, prompt decision, business-like despatch are the qualities desired in an architect's office as in a mercantile house; and the plans are made, the specifications written, the contracts drawn up, the superintendence followed up,—all according to the most approved business habits of the day. Design, alone, must needs suffer; and originality, as the true essence of design, must needs remain unregarded.

PRACTICAL MACHINE-SHOP INSTRUCTION IN TECHNICAL SCHOOLS.

By Prof. Joseph Torrey.

IN any discussion of technical-school instruction it must be treated as an existing, and not an imminent thing. It is out of the pioneer stage, and more or less independent of criticism. In fact, barring seniority, which is not a very lucrative possession, the technical schools have, all round, rather the best of the colleges. Any one who studies their history in this country will be greatly impressed with the high ideals and broad wisdom of the men who were instrumental in evolving them, and yet, if he has been a careful student of human history, he will say to himself that institutions have not always been able to carry out the purposes of their founders, and he will naturally inquire how far the ideals of the founders are being realized in the modern technical school.

In most modern systems of technical education the machine-shop holds a prominent place. What is its object? Is it intended to furnish a species of apprenticeship from which boys shall emerge machinists, or is it simply a laboratory and amenable to the same limitations and laws as any other educational instrument?

At the very outset we shall find that the answers to the foregoing questions depend largely on what answers we give to another similar set, involving the aims and objects of those who attend these schools, and the results of the training they gain there as shown by their after experience. These questions we can answer in a general way quite readily. The greater part of those who enter the technical schools are comparatively young students with often only a scanty equipment of fundamental knowledge. They enter on a technical course of training with a view to utilizing that training afterwards as a means of livelihood. Very few of them mean to be machinists, molders, engineers, carpenters, or mechanics of any kind. Many of them aspire to positions of responsibility and trust in manufacturing establishments, and by coming to the technical schools instead of serving an apprenticeship in the works they virtually pronounce it their opinion that, all things considered, this is the better and surer course to take.

If this is a fair statement of the case,—and I think it will be generally accepted as such,—we should expect to find the technical

schools planning their work and adjusting their equipment to meet the requirements of such a class of students as has been sketched. Educational institutions are molded not by trustees or founders in most cases, but by students. If then we enter upon any discussion of the methods and appliances of the school shops, it is clear that we must consider them from this point of view,—not as training schools for mechanics, but as having in view the development of men more particularly fitted to deal with wholes rather than with their parts. The question is then: Are the methods and appliances of the school shop adequate to the task of producing men capable of taking important positions without considerable supplementary experience in the works? First of all we must inquire, what are the qualities which such a position demands in him who holds it?

To begin, he must have a certain just and well-earned independence—or better, freedom—of thought and judgment. In the second place, he must be far-sighted, able to see over the heads of his men, planning far in advance such changes as will be necessary to meet the demands of the times, always watching tendencies and not the mere order of events. He need not be an especially skilful mechanic himself, but, if he can add this to the foregoing qualities, it will certainly increase his efficiency. Finally, he must command the respect and regard of those under him, and have the power to make them enter into his ideas and work out his plans. Such, broadly speaking, are the qualities which must characterize a man who holds any responsible position in a manufacturing establishment. Now let us analyze these requirements, see how they may be attained, and judge, as well as we can, whether the technical-school shops are likely to furnish the requisite conditions.

Independence of thought and judgment usually comes from two things,—experience and much thinking. Neither one alone can bring it about. The same is true, only perhaps in a higher degree, of far-sightedness. The other essential qualities mentioned are, I think it will be conceded, largely matters of temperament and disposition.

How much, now, can the technical school do toward equipping a man with such qualities? Can it, in the first place, give experience? If so, to what extent? This question has been discussed over and over again. The very best engineers in America have devoted special sessions of their meetings to it, but I cannot find that it has been seriously maintained that the amount of work done by a student in the shops of a technical school can be taken as so

much practical experience. The time is too short, the view too limited, and moreover there is lacking in most cases the reality of actual shop-work. The most serious obstacle, indeed, to the successful employment of the school shop as a means of actual practical experience is found not in the shop itself, though it has its limitations here, but in the student and in the atmosphere of student life. We may talk, if we please, about the earnestness of students, and may fancy, if we see fit, that we find more of this desirable element in the technical school than in the college, but as a matter of fact every year sees less and less difference between the institutions in this respect. In both of them conditions have changed considerably within the last ten years. The life of the student is more complex now than it formerly was, and the element of *study* is only one among a number, all of which demand some attention. As a whole the change has probably been a beneficial one, but we certainly have been obliged to forfeit something. Then again the very largely increased number of students, which is such a perplexing element in the educational problem to-day, has tended, as it must necessarily do, to make classes more unwieldy and work of all kinds more mechanical. Nor can it be truly said that the laboratory and laboratory instruction have escaped this. Every one who is connected with such instruction knows that most students regard the work simply as a set of things to be done, and in the doing of which they must attain a certain degree of accuracy. The question that the teacher hears most of in the laboratory and that depresses him most is "Will this do?" or "Is this good enough?" The mischief is often done, moreover, before the man gets to the college or the technical school. Their influence and traditions reach far back, to the boy in the grammar school, and in most cases when he comes to college or to his special school, whatever it be, he is entirely *au fait* and settles into the harness immediately with a pretty good understanding of what will be required of him, and how he can meet requirements most easily.

To some extent, then, we must take this matter into consideration. A young man working at his bench in the machine-shop of a school is a *student* and lives the life and thinks the thoughts of a student. Put the same man at work where he can barely earn a living and where a mistake means so much spoiled material and wasted time and may cause him to be put back, and he is obliged to labor in a very different way. It is one thing to stand over a steam-engine, take a few cards, adjust a valve, set an eccentric, or

scrape a bearing in the engine-room of the technical school, and quite another thing to stand over a fast engine driving machinery which *must not* stop and which has obligingly taken the opportunity to develop a hot crank-pin or a broken piston-ring. The mere agony of soul of such an hour calls out a man's resources as never before.

It is hardly possible to emphasize this point too strongly. The difference is not so much in the things done as in the attitude and standpoint of the man himself. If we undertake to criticise the equipment of the school shop and the plan of work therein carried out as if the fault were to be found there, we shall find our task a very difficult one. The tools and machines are in most cases excellent. If any criticism at all were to be made, perhaps the most just one would be that the machines and tools are a little too good. It certainly is a matter of experience that the best kind of apparatus for a beginner to work with is such as makes success depend, in the main, upon his own judgment and skill in handling it. The best training in measurement is afforded by comparatively rough instruments, stress being laid mainly on the point that with instruments of a certain degree of correctness we can reach a result of a certain order of accuracy. By studying carefully the conditions we can perhaps improve our first results a little: but ultimately we reach a well-defined limit which can be passed only by using better instruments. If this step be taken, and the possibilities and limitations of the problem be studied anew in the light of the increased field of errors introduced by changing to more delicate instruments, we can attain to a result which will be of a higher order of accuracy than the first one. I believe this principle could be applied with great advantage in some lines, at least, of shop-work. I have many times noticed in graduates of technical schools a tendency to use instruments in an unintelligent way. For instance, I have seen indicator-cards figured to the $\frac{1}{1000}$ of a horse-power when the reducing gear was very loose on centers and the cylinder had not been measured. I have seen measurements made with a wooden ruler graduated to $\frac{1}{16}''$ recorded to hundredths of an inch. I have seen the weight of cast-iron pieces calculated to the thousandth part of a pound with no real knowledge of conditions which would warrant such exactness of statement. Such performances are not by any means uncommon. One of the rarest sights to be seen in any kind of laboratory, mechanical or otherwise, is a student whose work is *consistent* throughout, and who has the judg-

ment to carry his measurements to a point indicated not by the limit of the graduation on the scale, but by his own clear perception of the conditions, requirements, and possibilities of the case.

I believe that a student will make better progress in this direction with rather rough instruments, but much can be done toward cultivating the corresponding habit of mind, no matter what kind of instruments are employed. So also with machine-work. It is not so important that a young man come from his shop training able to make a good fit, as it is that he be able to rightly estimate the real accuracy of his work. Let him be taught that he is not to ask his instructor whether the work is "close enough." He is to know for himself just how close it is, and just how well it meets the requirements of the case.

Students differ very widely in this respect. Some need only a hint, and never lose sight of the idea, which fits perfectly into their natural ways of doing things. Others learn only in a sort of automatic way, and never work with any freedom. It is vain to expect anything different. The engineering sense is, to a great extent, born in a man. If it is there, it will permeate any kind of a course of training whether taken at the apprentice's bench or in the shop of the technical school. If it is not there, no amount of training can *create* it. Some men who have had all the advantages of both school and shop experience seem never able to grasp firmly fundamental principles. One designs his first machine without any due appreciation of the fact that strength is good only when it is in the right place,—when it is actually opposed as a resistance to deflecting or distorting forces. Another, carried away by his interest in designing a certain piece, or carrying out a certain idea, emasculates his work by too much detail and wastes time and material on something which, when completed, is only a blunder. Or there is a failure, through short-sightedness, to provide for all the requirements. I recently saw a newly-designed tram locomotive in which the generally desirable quality of rigidity had been carried so far that the machine refused to go round a curve. Such mistakes as these do not always come from a lack of what I have called the engineering sense. Quite frequently they simply indicate the lack of a kind of experience which is only obtained by close and living contact with actual conditions as they are found in practice.

It is clear now, I think, that most of the qualities necessary to a man who is to take a responsible part in mechanical matters are

such as belong to a somewhat mature mind. In most cases time and experience only will bring such maturity, but certain it is that the school, and particularly the school shop, can bear a very important part, not only by supplying elementary knowledge, but by inducing in the student habits of mind which will follow him into active life. This, it seems to me, is the natural function of the technical school. While a man remains a student, he thinks and works as a student. He is impressed mainly with the multitude of facts surrounding him. He deals largely with books and thinks in book form. He has little experience to go on and so lives largely in the experience of others. All this is well if only his eye penetrates behind the practice and grasps the principle. Sometimes this is the case, but not generally. Whatever else may be said of the atmosphere of the modern technical school, it is not a reflective one.

Just here the influence of the teacher cannot be too strongly emphasized. If he is himself a practical man in the true sense, possessed of a clear head and of creative energy, one who has been accustomed to deal with facts at first hand, he can, if he has the spirit of a true teacher, impart to his students something of his own mental stamp, so that they too will think for themselves, and all their work will show the freshness of *real* originality. It has always seemed to me, moreover, that the students might profitably be thrown on their own resources more than is generally the case. Of course the chief obstacle to doing this lies in the effort to get a class over a certain amount—generally a considerable amount—of ground in a given time. It is just this effort that should be especially deplored as fatal to the attempt to turn out clear and independent thinkers. It is neither in amount of work done nor in multitude or completeness of appliances, but in the molding and enlarging influence of an inspiring teacher that the chief possibility of the technical school is to be found.

To sum up: the technical school furnishes, in its machine-shop, a laboratory, not an apprenticeship. Its constituents are students and its atmosphere that of a school. The instruction offered is, so far as courses and appliances are concerned, about as "practical" as it can be, and it should be of great value as a preparation for all grades of mechanical and technical work; but in precisely those points which are most indispensable to the training of a thorough mechanic, or indeed to any person who is to take a responsible position in mechanical matters, it is deficient. From

this statement of the case we should be led to expect what experience confirms,—namely, that in a considerable majority of cases the technical school graduate needs a supplementary apprenticeship before he is fit to take the position of foreman or superintendent. There are exceptions, of course. I have myself known one or two such cases.

Finally, any one looking over the problem of technical training, and inquiring how its work must be planned so as to do for a young man the most possible in a given time, can see many things that would be desirable if practicable. For instance, it would be desirable if students could come with more of a good foundation of general education under them. We in the colleges echo the wish, but it sometimes seems as if every tendency were in the opposite direction. It would be a great step in advance if men would come to the higher schools mature enough to know what they can do and what they want to do. Then if instructors could only tell certain students that they have no business in a technical school and never will have,—not roughly but kindly,—and give them some advice as to what they had better do; if, in short, there could be more *selection*, and the numbers to be handled reduced somewhat,—everything could be done better. As things are now constituted and now tending, it does not seem as if much could be done in any of the above directions. How much difference it would make in the situation if the technical schools really tried to be *selective* is a question. The experiment is certainly impracticable under existing conditions, but one can hardly help wishing it could be tried. One thing is certain: minds cannot be trained by machinery, and in general, as our educational institutions become more crowded, instruction will certainly become and is now becoming more and more machine-like. If the time ever comes when the colleges and technical schools are less crowded, and when more men stop with an ordinarily good high school education,—a state of things which would have its advantages,—there is no doubt but more will be accomplished in the line of making thinkers in both technical school and college. Either this must be the case, or evolution must work some change in the coming student, by virtue of which he will be led to reflect and think under conditions not favorable to the student of to-day.

THE ART AND DEVELOPMENT OF TOPOGRAPHIC MAPPING.

By Arthur Winslow.

TOPOGRAPHY is a word which means, strictly speaking, a description of a place or tract of country, relating to its natural or to its artificial features, or to both. Correspondingly, topographic maps have been made to include a great variety of objects, natural and cultural. Nowadays, however, the distinctive feature of a topographic map, as commonly conceived, is the representation of features of relief, and such a map is more exactly designated, perhaps, as an orographic or hypsometric map.

The construction of maps dates from the dawn of history. A papyrus in the Turin museum has been identified as the topographic map of a gold-mine in Nubia constructed prior to 1500 B. C. Anaximander of Miletus (634-546 B. C.) is credited among the Greeks with having made the first maps. Parmenides of Elea (460 B. C.) demonstrated that the earth was a globe, and in the years following a real advance in cartography was made. Ptolemy's historic atlas was prepared about 150 B. C., and in the succeeding centuries the production of maps of greater or less worth was comparatively common.

The importance of maps for administrative and war purposes was early appreciated by many governments, and national maps of varying character were constructed at early dates. Of the kingdom of Wurtemberg in Germany, an unpublished map was prepared as early as 1452. Maps of Bavaria prepared early in the sixteenth century were used for 200 years. The earliest known atlas of Austria is from eleven wood-cuts dated 1561. The first map of Russia, made about 1550, and known as "The Great Drawing," has been lost. Printed maps were prepared a little later. Peter the Great, appreciating the importance of maps, ordered the execution of surveys and the preparation of maps as early as 1720.

The earlier maps attempted generally only a representation of the outlines of continents and seas, the delineation of great rivers, the tracing of national or tribal boundaries, and the location of large cities. Many compilations were, however, also covered with

fantastic figures and designs illustrating the population, fauna, and resources of distant lands. In some cases rude attempts were made to show mountain systems, in which attempts we may recognize the embryonic desire to portray the relief of the earth's surface. Indeed, as far back as the old Turin papyrus there is a weak effort to picture mountain chains. On other later maps we find small mound-like designs, or rough angular dashes drawn in succession to indicate mountains, and, as we pass on from these, we find these additions growing in art and accuracy. On maps of the eighteenth century and the early part of the nineteenth infinite labor in draughting was often applied to cover the surface of the map with such conventions, which, though often expressing much detail and of excellent artistic effect, yet conveyed only general ideas of distribution and little or nothing of the relative magnitude and true shape of elevations. On a map of the Breisgau published by Homann in 1718, according to Ravenstein, is what is considered the first noteworthy attempt to represent elevations, as seen from a bird's-eye view, and of shading them according to the steepness of slope. This became soon more fully developed, and was popularized later by Arrowsmith. Here, however, everything was left to the judgment of the draughtsman, and not until Lehman, in 1783, had proportioned the strength of the hachuring to the steepness of slope, and virtually introduced a series of contour lines, was exactness possible. In 1737 Philip Buache prepared a contour map of the British channel and suggested the application of the system to land surfaces. It was soon after put in practice in France, which has the credit of having first undertaken a scientific topographic survey, about 1744.* England followed close on the footsteps of France. The first work here was a systematic survey of the Scottish highlands, begun in 1747, and a general trigonometric survey was ordered in 1791. Other European countries soon engaged in like work, and the present century has been one of great activity in this direction. At present almost the whole of Europe has been mapped in great detail, and considerable parts of North America, Asia, and Africa. The accompanying table, extracted from Mr. J. G. Bartholomew's valuable article on "The Mapping of the World," published in the *Scottish Geographical Magazine* of June, 1890, shows the distribution of this work :

*Later the production of topographic maps was much encouraged and developed through the influence of Napoleon I.

TABLE SHOWING THE EXTENT OF DETAILED TOPOGRAPHICAL SURVEYS.

Continental Divisions.	Area in square Miles.	Area Undergoing Survey.	Area not Undergoing Survey.	Remarks.
Europe	3,757,000	3,413,000	344,000	All except Turkey, Bulgaria, and Luxemburg.
Asia	17,213,000	2,368,000	14,845,000	Only India, Java, and part of Japan.
Africa	11,515,000	280,000	11,235,000	Only Algeria, Tunis, and Egypt.
North America	7,900,000	2,000,000	5,900,000	Geological Surveys of the U. S. and Canada in progress.
South America	6,855,000	.....	6,855,000	No Detailed Surveys.
Australasia	3,200,000	.....	3,200,000	"
Polar regions	2,000,000	.....	2,000,000	Unexplored.
Totals	52,440,000	8,061,000	44,379,000	

The construction of maps has grown out of the desire to convey graphically a mental picture of geographic facts and to preserve this picture for use and record. The few lines of even the crudest maps convey more than could be expressed by a long verbal description, and convey this more clearly and impressively. It was in furtherance of this idea that the fantastic figures of animals and other characters were added to early maps, and that explanatory notes were frequently introduced. Out of these has grown the elaborate series of conventions which are incorporated in our modern maps. Maps, in the early stage of their construction, were used as guides in exploration and for recording and illustrating State and land boundaries. In later years they were extensively prepared for military purposes. Their value in recording property divisions, and as a basis for land-taxation, led, centuries ago, to the preparation of exact plans or maps known as cadastral maps, which, according to the definition of the term, are maps from which land-areas may be computed and their revenues determined. These were generally without topography at first, but features of relief were added later.

The great importance of topographic maps in military campaigns was perhaps the most powerful among the first causes which prompted their preparation. Once prepared, however, their value for

many civil purposes soon became apparent, and this has led to the construction of such maps in almost all civilized countries, on large scales, permitting the introduction of much detail. Nowadays topographic maps are acknowledged as invaluable for the promotion of agriculture, commerce, and mining; for interior improvements, in the construction of railways, roads, canals, and harbors; for irrigation, drainage, and artesian boring; for the management of forests; for determining drainage-areas and reservoir-sites; for delineating the geology and the distribution of mineral products; for illustrating the development of geographic features and for many other educational and scientific purposes; for establishing boundaries and frontiers, and for reference in administration and legislation.

Just how topographic maps are useful in all these connections can perhaps best be imagined by conceiving that a perfect topographic map is like an exact miniature of the surface it represents. It is as if the face of the earth were shrunken to Lilliputian dimensions, and spread out before one on the table for study and guidance. On it are represented a multitude of facts of location, distribution, and altitude, which years of travel and familiarity with the ground would not furnish; and these are presented in such a way that you obtain a comprehensive conception of the relationship of parts which can be acquired in no other way. When to the picture of the relief are added cultural features, such as roads, bridges, and boundaries, or facts of geology, and forestry, or any other occurrences, their locations are so clearly and graphically shown that one can place them on the ground at once.

It is true that for topographic maps to serve all these important ends to full satisfaction they must be of large scale, and constructed in great detail at a corresponding large cost. Probably the smallest scale that will fully admit of all these uses is 1:2500, or about 25 inches to the mile, which is the scale of the "parish plans" of the British Ordnance Survey. In proportion as maps are on a smaller scale than this, or are less carefully constructed, will they fail to meet all the requirements. Still, topographic maps on scales of one or two miles to the inch, constructed with a faithfulness commensurate to the scale, remain valuable for many of the purposes enumerated.

The United States is undoubtedly less satisfactorily mapped, according to modern ideas, than is the territory of any other important and equally civilized nation. Indeed, it is only during the

past thirty years that any general topographic mapping of inland areas has been undertaken. A brief reference to these surveys will be in place here.

We are all more or less familiar with the system of public-land surveys which was put in practice towards the end of the last century, and which has continued up to the present date. It has now covered nearly all of the western, and some of the eastern States. By this system the land is divided into townships of six miles square. The maps prepared from these surveys, though serving many useful purposes, lack accuracy in many respects, contain little geographic information, and are entirely destitute of hypsometric data.

The military and other explorations of the western country, conducted during the early part of the present century, though yielding abundant general geographic information, did not produce any maps such as are now classed as topographic.

The ground-work for such cartographic development, therefore, may be considered to have begun, and this in a most admirable manner, with the planning of the United States Coast and Geodetic Survey by Hassler in 1807, though actual work was hardly started before 1832. The work of this survey embraces the accurate delineation of the whole coast-line, including all bays and rivers up to the head of tide-water. Further the work extends inland as far as necessary for coast defense, and out to sea twenty leagues. In addition, triangulation of the highest order and lines of precise levels are extended into the interior, and one chain of triangles will soon be completed across the continent. The charts prepared are of different kinds and scales, ranging from 1:5000 to 1:80,000, with contour intervals of 10 and 20 feet. The majority are about six inches to the mile. On these charts the topography of the land adjacent to the coast is shown with great minuteness, and innumerable facts of value to the navigator are incorporated. Nearly the entire coast-line is now mapped, and in all about 34,000 square miles have been topographically surveyed.

The survey of the great lakes was inaugurated in 1841 and continued forty years. It was conducted under the Engineer corps of the United States army, the work being based upon triangulation of the most accurate character. A narrow strip along the whole shore line of the United States was topographically mapped on scales varying from 1:5000 to 1:600,000. The relief on the older charts was shown by hachures, on the later ones by contours.

Several other surveys by the national government were prosecuted between the years 1867 and 1879. The survey of the Fortieth Parallel was organized for the purpose of exploring a strip of country along the Union Pacific and Central Pacific railways, about 100 miles wide and extending from the western border of Nevada to the eastern base of the Rocky mountains. This was triangulated and mapped topographically with barometric and vertical angle altitude determinations and sketched topography. The field of what is known as the Hayden survey extended into Montana, Idaho, Colorado, Arizona, New Mexico, Utah, and Wyoming, embracing topographic sketch-mapping controlled by triangulation. Under the Powell survey of the Colorado river about 67,000 square miles were mapped in Utah and Arizona ; the work was controlled by triangulation, and the topography was drawn on plane tables. The Wheeler Geographical survey west of the One-hundredth Meridian, begun in 1869 as a topographic reconnaissance, was reorganized in 1872 and continued until 1879 ; about 360,000 miles were surveyed. Under the control of the War Department surveys had been conducted since 1878 in great detail along the Mississippi and Missouri rivers, and a strip of country on each side of those streams has been mapped topographically, work being controlled by triangulation and carefully-checked levels.

The most advanced step towards a general topographic atlas of the country has been made by the existing United States Geological Survey, since its organization in 1879. The work grew out of the necessity for a topographic base in the preparation of a geologic atlas. The maps, though primarily adapted to this end, are, however, calculated to answer many of the other requirements of topographic maps. The work is in great part controlled by triangulation of moderate refinement; altitudes are determined primarily by vertical angle measurements and secondarily by aneroid barometers. The topography is largely drawn on plane tables by intersections, supplemented by odometer meanders along roads. All reliable results of previous work by other organizations are made use of. The work has now been extended over a large portion of the country both in the west and east, and some few eastern States have been entirely mapped on a plan of coöperation between the national and State governments. Altogether 550,000 square miles have been surveyed.

Besides these surveys of the national government, various States

have mapped portions of their territories in greater or less detail, including New Hampshire, New York, Pennsylvania, New Jersey, Kentucky, Wisconsin, Minnesota, Missouri, Arkansas, Texas, and California.

Did space permit, it would be of interest to describe in greater detail the processes and results of all these various home surveys, but we must be content with the following tabular summary of the results to date :

AREAS REPRESENTED ON VARIOUS MOTHER MAPS OF THE UNITED STATES.*

	Square miles.
Scale of 1 mile to the inch, all in contours	100,000
Scale of 2 miles to the inch, all in contours	360,000
Scale of 4 miles to the inch, all but 60,000 in contours	460,000
Scale of 8 miles to the inch, 860,000 in contours ; 160,000 in hachures ; remainder show no relief	1,530,000
Scale of 16 miles to the inch, same as above	350,000
Total	2,800,000

This leaves only about 8 per cent. of our country, exclusive of Alaska, unsurveyed.

Though it would appear that almost the whole of the United States has been mapped, we must not be misled into the idea that this has been done in a final manner. On the contrary, the result so far is only a stage in the development of our cartography. Undoubtedly the great portion of this mapping is inferior to that of European nations, and is not calculated to satisfy the needs of a densely-populated country. But we must remember that the results so far have been attained at a comparatively small cost, to satisfy present needs. As soon as our people become educated to its value to the extent of providing the necessary means, the highly exact cartography will follow.

Money is not the only essential, however, for the production of good topographic maps. Cultivated minds and trained hands must be provided also. It has been no small obstacle to the advancement of such work in this country that competent topographers cannot be obtained in sufficient numbers. We have an abundance of surveyors who can run a level or compass, a transit, or even a plane table, and who have some experience in such topographic work as is generally part of a railway survey. But men who have

*These figures are extracted from a table published by Mr. Henry Gannett, Chief Geographer of the United States Geological Survey, in a paper entitled "The Mother Maps of the United States," in the *National Geographic Magazine*. The reader is referred to this paper for much additional interesting information on the subject.

an eye for topography, in whom what we may call the topographic sense is fully developed, are few and far between. Topographic mapping is far from being a mere mechanical operation. It is a simple problem to determine distances and altitudes and to connect points of equal elevation by contour lines; but it is an entirely different matter to draw these lines so that they shall faithfully convey the true expression of the topography, without which so much of its meaning must be lost. In this lies the art of topographic mapping, the perfection of which demands an eye for detail.

To effectively practise the art recourse must be had to the science of topography. Topographic forms must be studied, mastered, and classified, and types defined; their relationships must be understood, and something of their history appreciated. This involves a consideration of the origin and development of the physical features of the earth's surface, and a dip, at least, into the subjects of geological structure and history.

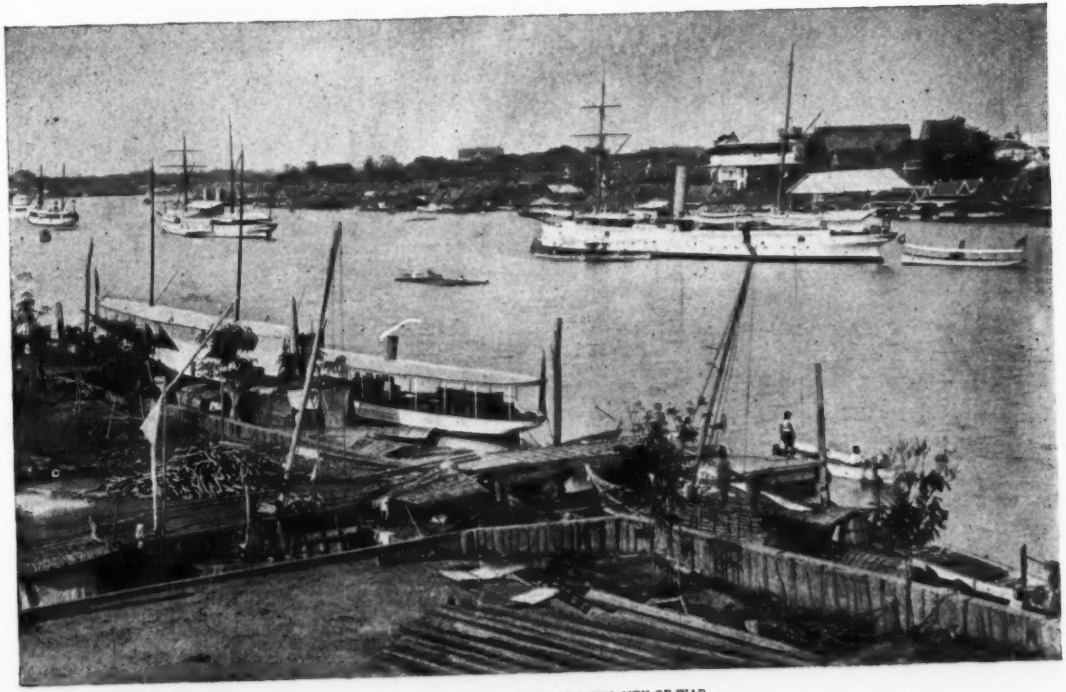
We have a great plenty of text-books and courses of instruction which tell all about the make and use of the many different surveying instruments, which explain the processes of surveying and the preparation of contoured maps as adjuncts to civil engineering; but of text-books or lectures which attempt to inculcate the principles of the science of topography as here defined, and to train in the art of topographic mapping, there is almost an entire dearth. The most noteworthy move in this direction during recent years has been at Harvard, thanks to the discernment and energy of Professor W. M. Davis, professor of physical geography at that university. The science of geography with especial reference to the origin and growth of topographic features is there taught in a most interesting and attractive manner. We should have more of such teaching, and we *must* have more if cartography in the United States is to reach a high degree of excellence. Skill and training in the mechanical processes must undoubtedly be developed even to the height of an art; but, over and above this, the higher intelligence must be appealed to if enthusiasm is to be aroused and interest sustained. Only through such intellectual interest in a worthy theme, through such understanding of causes and effects, is the best work done.

RECENT PROGRESS IN SIAM.

By J. B. Breuer, Bangkok.

IT is not so very long since the knowledge of Siam possessed in most western countries related chiefly to the Siamese twins having been born there. Their deformity not only established their own fame around the globe, but made the name of their country known. Some of the better-informed had heard of Siam as the home of the White Elephant, worshipped alike by a diamond-wearing king and a half-barbarian population. But if one had asked the name of the capital of Siam, or to what country Bangkok belonged, correct answers would not, in many cases, have been forthcoming. During the past summer, however, this country has been brought within the focus of general attention and interest in consequence of the diplomatic difficulties with France. The political questions involved have been discussed at great length in the newspapers, but it may be of interest to consider the status of culture and progress in this east Asiatic kingdom, which, as will be shown, fully deserves the sympathy bestowed upon it of late by the civilized world.

Siam seems a small country, as shown on the map of Asia, but its area of 270,000 square miles is greater than that of Germany. The population is scant, however, not exceeding eight millions in all, and rapidly decreasing in density as one travels from the south to the north. The southern part of the country is of alluvial formation, as shown by the discovery at Bangkok of sea-shells twenty feet below the surface. The fertile soil here produces a vegetation of unrivalled luxuriance, from the cocoanut-tree to the most exquisite fruit-bearing species. But the scenery is somewhat dull and monotonous, immense plains alternating with impenetrable, endless jungle. Here is the home of numerous herds of elephants, water-buffalo, wild bullocks, and magnificent stags which are the sportsman's joy. Among the smaller zoological species is a peculiar kind of monkey, with long, grey, silken hair, and a plaintive, human-like voice. Innumerable birds and a large variety of poisonous and harmless snakes are also found. But the level aspect of the country changes toward the north, where a mountainous character prevails. Here is the realm of the tiger,



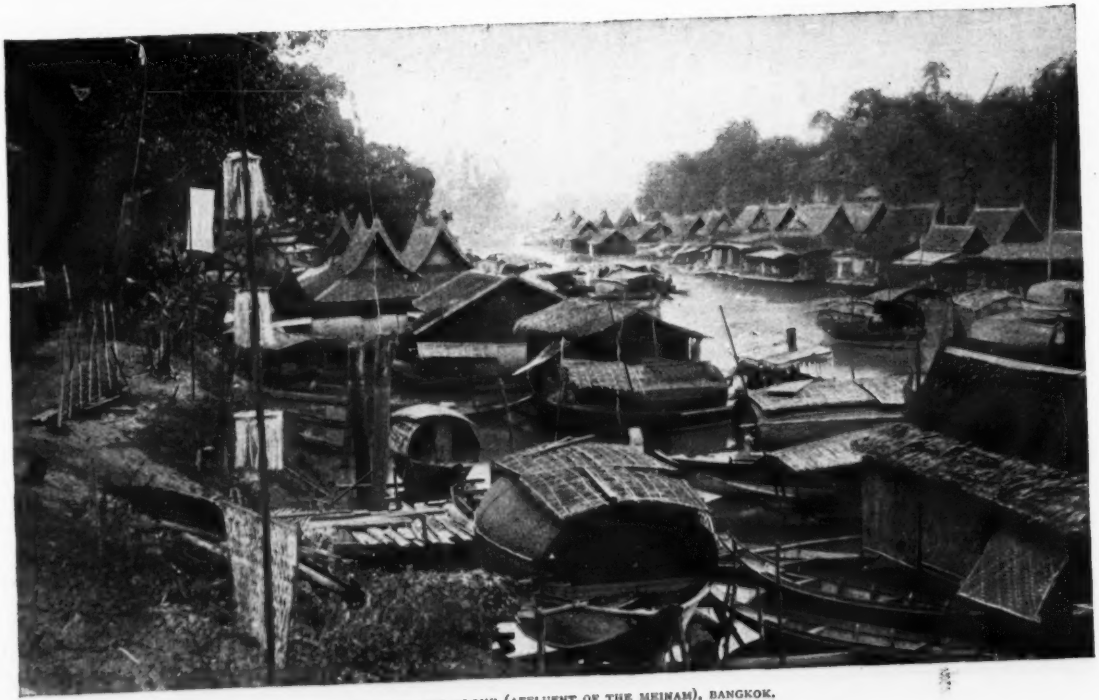
THE RIVER MEINAM, WITH SIAMESE MEN-OF-WAR.

which, not extirpated systematically as yet, is more frequently seen than in British India. The Malay peninsula, being for the greater part under Siamese rule, and stretching out its long branch down to Singapore, the grand thoroughfare of Eastern trade, is also mostly of a hilly formation.

Two mighty streams flowing from north to south form the chief arteries of travel and commerce in Siam,—the Meinam and Mekong rivers. The delta of the Meinam forms the great natural commercial center of the country. The name of this river indicates the great importance attached to it, being formed from two Siamese words which signify "mother of the water." Indeed, to a certain extent the Meinam plays the same rôle in Siam that the Nile did and does in the land of the Pharaohs. During the rainy season the river, with its affluents, overflows several thousand square miles of country, preparing it for the production of rice, the chief victual for the inhabitants and also the chief article for export.

As in every tropical country, there is a characteristic rainy period in Siam, which lasts from May until the end of October. This period is followed by the cold season, from November until the end of February, and in March the hot season begins, lasting until the middle of May. Of course the term "cold" must be taken in a relative sense, the lowest temperature ever recorded having been 57°. The maximum height of the thermometer is about 98°. Considering such permanently high temperatures, life in this latitude might seem impossible for Americans or Europeans were it not for the two winds called the southwest and northeast monsoon, which yield refreshing breezes at periodical intervals. Still the climate is an extremely relaxing one, and does not fail to exert an enervating influence on the population.

Scarcely half the inhabitants may properly be called Siamese. Two millions are represented by the Laos, a tribe conquered by the Siamese early in this century, clever in industrial arts, and differing from their conquerors little save in dialect. Another million is represented by the smart and warlike Malays, and another million by the Chinese, who, as tradesmen, are penetrating the whole of the far East. Born under an ever-smiling, bright sky, needing little in the way of wearing apparel, contented with rice, a little fruit, and the traditional betel-nut for chewing,—things which the soil offers almost without effort on his part,—the Siamese native knows little of the sorrows of to-morrow. Consequently we find him of a bright, inoffensive, and even careless nature. Like all



VIEW OF THE KLONG (AFFLUENT OF THE MEINAM), BANGKOK.

Orientals he is fond of jewelry, and if he has some money he spends it for purposes of ornamentation for himself, his wife, and his children. Babies overloaded with ornaments of gold and precious stones are a frequent sight in the streets of Bangkok. The Siamese is less active than the Mălay and far less busy than the Chinaman. He considers himself a born gentleman, and manifests it by his attire, his walk, and his manners, which are proud, however poor he may be. But he is not unwilling to work, and, although a little slow, is clever in whatever he does. This people is ruled by a king who, surrounded by a court of princes, ministers, and counselors, has made progress the supreme law of his régime. The king of Siam is an ardent protector of strangers, encouraging their commercial or industrial interests in a simply royal way. The great variety of Siamese products suited for export has attracted a large number of foreign settlers, most of whom have met with success. Many European firms, but mostly English and German, flourish on the Meinam, exporting rice, teakwood, cocoa-oil, sugar, sandalwood, skins, and other products. The chief imports are cotton goods, hardware, glassware, petroleum, drugs, and an immense amount of fancy articles. The commodities in which the export trade is conducted on a really grand scale are rice and teakwood. Siamese rice ranks high in the markets, and the teakwood found there closely approaches in value that of Ceylon, which is considered as the very best. Unlike the majority of hard woods, the Siamese teak is easily workable, of very close grain, and, from its oily nature, almost imperishable. Nearly every day steamers start from Bangkok to Singapore and vice versa, making the voyage, according to the monsoon winds, in from four-and-a-half to six days. In Singapore the cargo is transshipped, either on the main line of commerce westward bound for Colombo, Aden, Port Said, and the European ports, or southward for the neighboring Sunda archipelago or for Australia, or eastward for the Philippines.

Transportation between Bangkok and Singapore is maintained chiefly by an English company known locally as the "Blue Funnel line." Though only of medium tonnage,—from about 500 upwards,—they are smart, well-constructed boats, commanded by English officers. The crew are chiefly Malays, these small but vigorous and elastic people making excellent sailors. Another line is owned by a rich Chinese rice company in Bangkok. There is a regular service between Bangkok and Hong Kong, without touching Singa-

PORT OF KLONG-KHUT-MAI, NEAR BANGKOK.

[Near the starting-point of the Khorat railway, where an imposing terminal building is to be erected.]

pore, by the Scottish Oriental Steamship Company, who have eight first-class steamers, each bearing the name of some monarch or prince illustrious in Siamese history. Bangkok's natural harbor is the river Meinam. Every steamer has to cross the bar at the mouth of the river, thirty miles below the capital. The bar allows large steamers to pass only at high tide, a nuisance of which every ship-captain and every foreign merchant complains. Many times the question has been raised of removing this obstacle by the use of dynamite, but the Siamese government has objected, deeming it wiser to maintain this bar as a natural wall of defense against the big men-of-war in the case of any international difficulties. How slight is its value as a means of defense has been demonstrated lately by the French naval maneuvers, and it doubtless will be only a question of time when the bar will cease to be an obstacle to commerce.

A SIAMESE POSTMAN.

Bangkok, as the capital of the country, is the center of all commercial and industrial movement and interest. The sight of the city from the river, where lie at anchor large and small steamers and sailing vessels, and the primitive Chinese djunks; the tossing and running about of hundreds of load-carrying kulis; the never-ending humming and singing of rice-mill and saw-mill; the shrill whistling of boilers and the dull hammering from the docks,—all this leaves

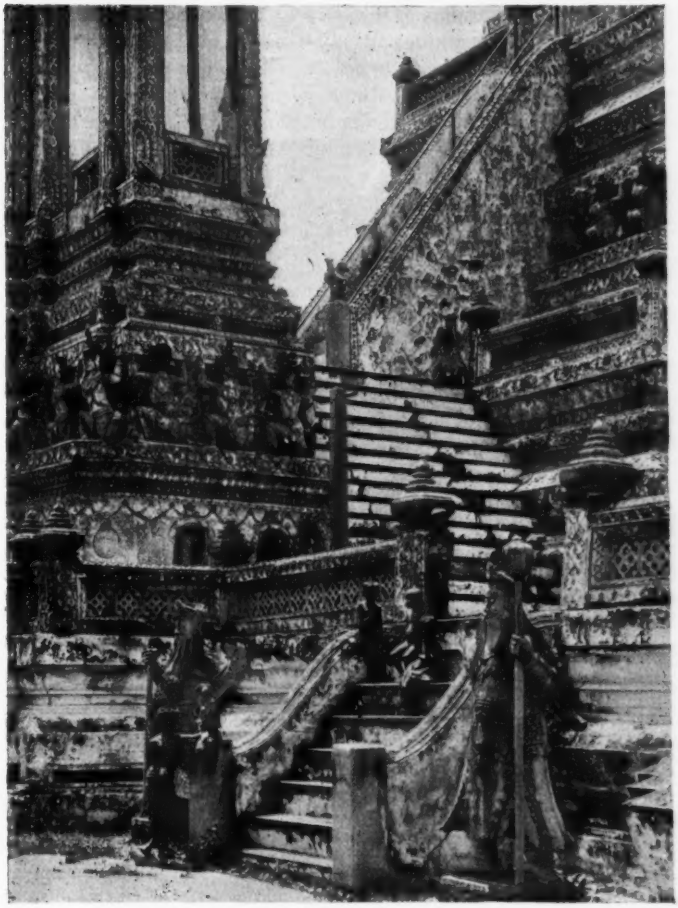
THE WAT CHENG, PRINCIPAL TEMPLE AT BANGKOK.

ARTICLES FOR DINNER SERVICE AMONG WEALTHY SIAMESE.

an indelible impression on a new-comer and makes him feel in the midst of a modern metropolis like Hong Kong, or Shanghai, or Bombay, all three of which are under English rule. But no, we are in the capital of an Asiatic king, though a king whose problem, like that of his father, is to carry forward his subjects in the direction of civilization and progress. Though at the head of a country whose natural products and climate are such as to tempt to inaction, this enlightened monarch and the royal princes in his suite—who have partly got their education in Europe—have made it their constant study to go ahead. They never go backward. It thus happens that there has been brought to the aid of the government a staff embracing many excellent men as advisers in the different branches of administration, which they have arranged on quite modern principles.

Siam has its foreign office, its educational and financial departments, its ministry of public works, and its geological, mining, and agricultural bureaus. Besides, the commercial interest of the country is fostered by a well-managed system of customs,—the merit of

which is largely due to Mr. Williams, an Englishman,—and an elaborate postal service, which until lately was under the care of Herr Stratz, assisted by other German postal officers. There is a most



DETAIL OF THE TEMPLE WAT CHENG.

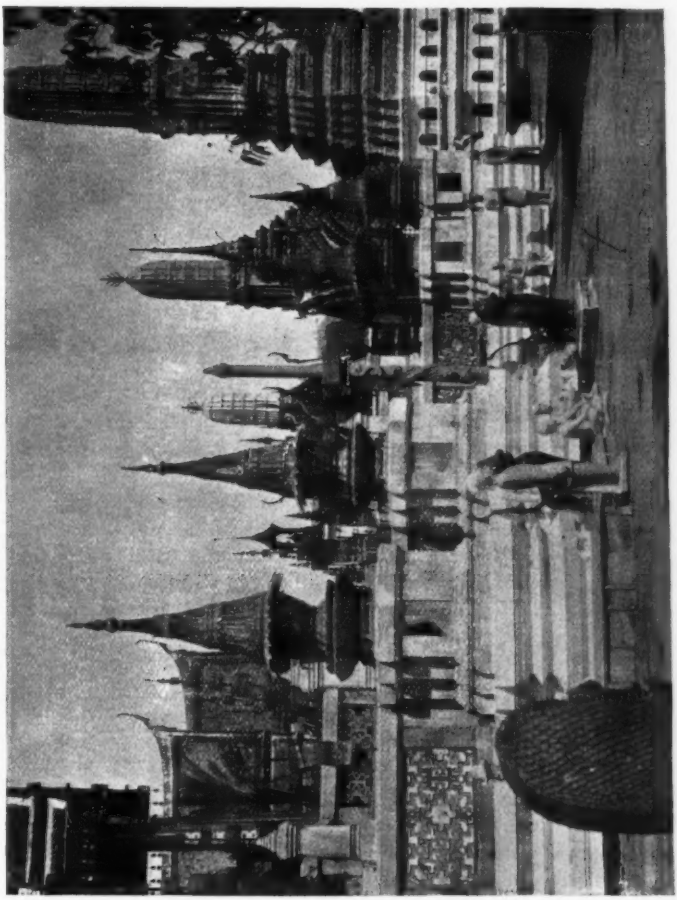
ingenious parcel post and even a money-order system between Siam and the rest of the world. The postal service embraces about forty branch offices in the interior, regular intercourse between which is

maintained by steamers, row-boats, elephants, and messengers on foot. Certainly a great deal has been done by the government for the welfare of the country. So far it appears to have been done under an enormous financial sacrifice, but it must be considered that most of the institutions are as yet only in the beginning of their development, time enough for results not having elapsed. Owing to the tropical nature of the country, progress must necessarily be less rapid in Siam than in Japan, but this may be considered rather as a benefit, for the over-hastened development of the Japanese has produced some awkward consequences.

A particularly rich field for agricultural operations is offered in Siam. Immense districts lie inert and uncultivated, partly from the scarcity of population, partly from the want of an adequate irrigation system, and last, but not least, from insufficient means of transportation. Irrigation is partly supplied by the affluents of the Meinam and Mekong rivers, but this water net-work needs to be largely extended, in which direction something has already been done in the cutting of irrigation-channels beyond the points reached by the creeks. Roads have been built across the country for connecting the chief provinces and centers of population, but these roads are difficult to maintain. Nothing is more destructive to

A SIAMESE PONY-CART.

roads than a tropical rain lasting for months, and the situation is rendered worse by the incredible energy of vegetation, which entirely closes to-day what the axe cleared away only a few weeks ago. Conveyance on these roads hitherto has been by elephants and bullock-carts, neither of which is rapid or comfortable. Horses do not stand the climate, being subject to many diseases. Ponies are successfully used for dog-carts and other light vehicles, but are not

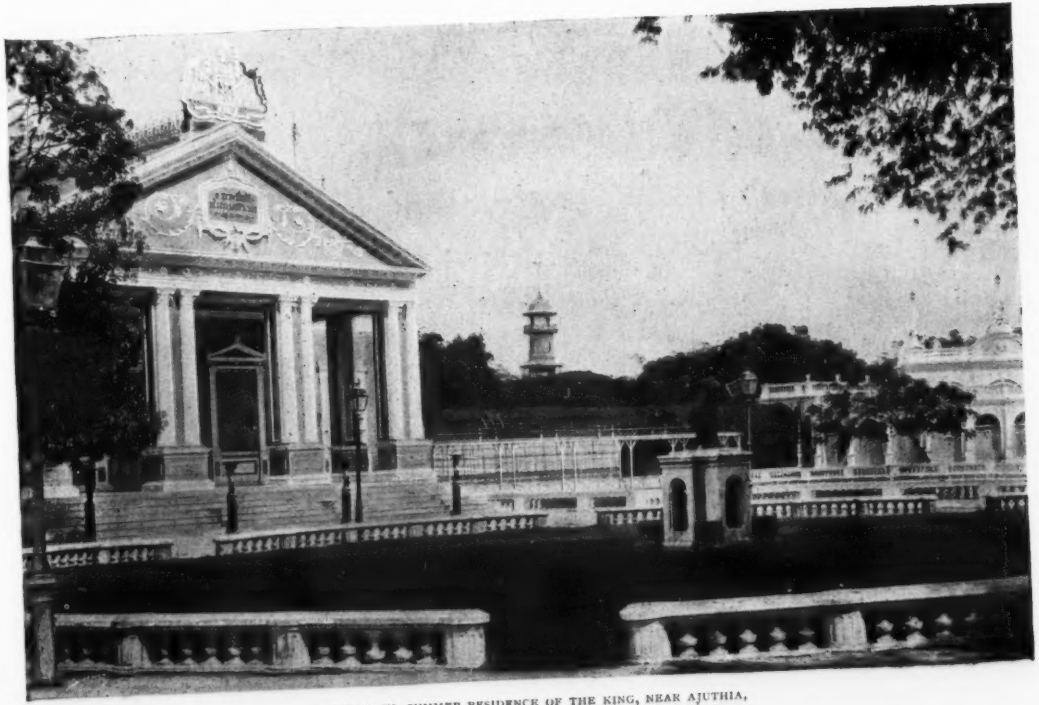


ROYAL TEMPLE COURT, WITHIN ROYAL PALACE GROUNDS, BANGKOK.

BUFFALO-CART AND DRIVER IN SIAM.

available for long distances. It happens, therefore, that the idea of building railways throughout the kingdom has occurred to the government as essential to properly opening the country.

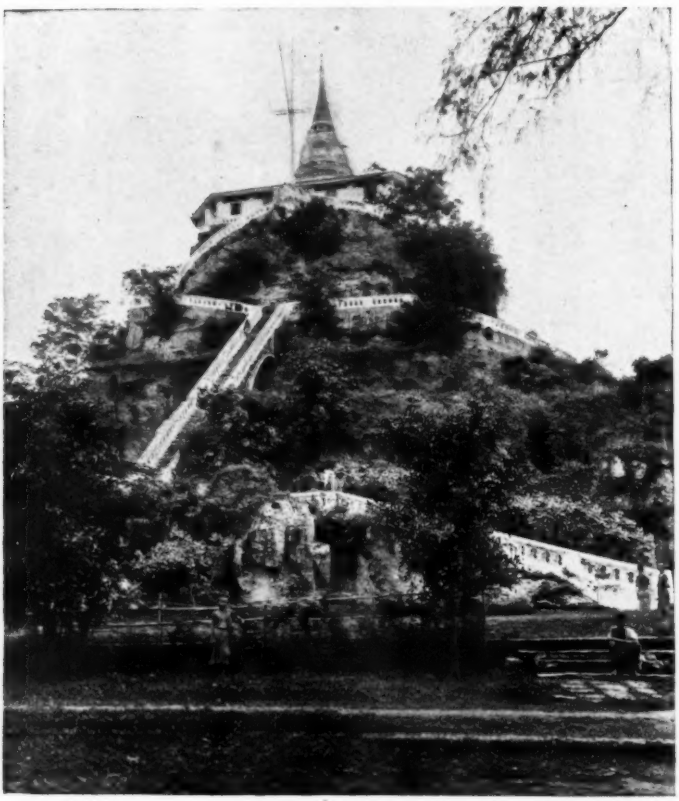
Four years ago some European engineers were called out for the work of inspection. Mr. Bethge, who had been identified with the St. Gotthard (Switzerland) railway, handed to the government a most promising report, and was authorized to push forward a line in a northeasterly direction, connecting the capital with the Khorat mountains, being of about the same length as the shore line leading from New York city to Boston. The lowest tender for the work was that of the English firm of Murray Campbell & Co., to whom the contract was awarded. Both Mr. Bethge, as director general, and Mr. Campbell, as the contractor, have staffs of junior engineers, besides which there is a chief engineer for the government,—a Mr. Rohns, who is of the highest professional standing. It is expected that this line will be completed next year, and, if its operations should prove successful, it will be followed by other similar enterprises, unless the recent Franco-Siamese difficulties should have the



BANG-PAHIN, SUMMER RESIDENCE OF THE KING, NEAR AJUTHIA.

effect for awhile of checking progress. It must be understood that Siam is not fabulously rich, but it has so far avoided public debts. It only remains to see how the country will bear up under the immense contribution forced upon it by the French. Before the Khorat railway was begun there was a short local line already in course of construction between Bangkok and Pak-Nam, at the mouth of the Meinam.

The development of railways is desired not only for extending



THE WAT SAKET, TEMPLE AT BANGKOK.

[Constructed on an artificial hill of brick. Contains a sacred tooth of Buddha, in honor of which there is a yearly procession.]

BULLOCK-CARTS AND GHARRIES (COACHES) IN BANGKOK.

[In the back ground is a Chinese tempie.]

A SIAMESE PRINCESS.

agriculture, but also by timber merchants having large interests in teak-wood lying beyond the points reached by river navigation. The export of rice is hampered in many quarters by the low water. The mining industry is also to be considered as promising a further development with the building of railways. Besides the products suitable for export already mentioned are pepper, coffee, gum benjamin, indigo, aloes, cotton, tobacco, and even gutta-percha. Up to date most of these articles have been produced only on a small scale, but the proof is afforded that they exist, and that their production is limited only by the lack of facilities for communication. At least this is an important point of view of the Siamese government. Something may be said in particular about gutta-percha. As is well known, the supply of this important commodity has become a matter of concern on account of the growing scarcity of the trees producing it. While the demand for this substance is annually increasing, and becoming more worldwide, the possibilities of obtaining it are diminishing in consequence of the wholesale destruction of the trees which has long been in progress. In Java it has been almost exterminated, while in Sumatra, Borneo, and the Malay peninsula the stock has been diminished to a ruinous extent. This has induced the formation of a company for the purpose of purchasing and erecting a newly-patented invention by

M. Rigole, of France, for extracting gutta-percha from the leaves and twigs of the *Isonandra dichopsis*. This process will, in the opinion of the inventor, insure a chance of obtaining in a few years an unlimited supply of the very best gutta-percha, the process allowing the tree to be utilized continuously during the whole period of its existence, instead of being cut down and destroyed for a single yield of gutta as is now the rule. An estate has been chosen in the island of Pulo Obin, belonging to the Malay peninsula, near Singapore, for the establishment of a factory and the planting of trees. The government has expressed its willingness to give to the syndicate leases of land, and has also offered to protect M. Rigole's patent within Siamese territory.

A SIAMESE WOMAN.

The government has displayed a liberal generosity in the encouragement of the work in the gold-fields at Bantapan, and also in the sapphire- and ruby-mines. Mr. C. Preston Gibbons left for England a few months ago, taking with him several samples of the ruby-producing strata of various mines of the companies represented by him, for the purpose of putting them through washing-machines and so trying the latter before shipping them to Siam, where they are to supplant Burmese labor. Furthermore, a liberal concession has been given to a leading Bangkok firm for mining coal in the Malay peninsula. But not all concessions given in Siam

have yielded great results. Some have proved entire failures, especially through having become the bases of doubtful maneuvers on European exchanges before the first sod had been turned for exploration. Guided by experiences in this line, the government has become more cautious and less prodigal in granting licenses to private companies. There is now a government mining department, at the head of which is Mr. de Muller, an English geologist well known by his work in Australia and South America, and all proposed mining schemes hereafter are to be rigidly examined.

After having been shown what are the prospects for the trader, the planter, and the miner in the interior, the reader is invited to follow us back to the "Residence," which now means Siam even more than Paris means France. One who takes a walk through the city will be surprised at the number of modern royal and other public buildings of tasteful architecture, adapted to the climate by large, overhanging, shady roofs, and ample cool piazzas and verandas. He will see colleges, barracks, administration buildings, a court of justice, jails like those in Colombo or Bombay, children's homes, and a public park where he may be struck by the familiar

FRUIT ON THE TABLE OF A EUROPEAN RESIDENT.
[Including the Duria-fruit, Mango, and Mangustine.]

PALISADES FOR ELEPHANT-HUNTING, ON THE UPPER MEINAM.

sounds of one of Strauss's waltzes or an overture correctly played by military bands. In these colleges boys of the better class learn English and mathematics from European teachers. In the courts of the barracks the infantry, armed with Mannlicher rifles, are drilled to a degree of perfection which would appeal to the interest of a Prussian officer. Then he might pass a ministerial building, for instance, the Foreign office, where messengers are running up and down like bees in a hive, or the wonderful lofty structure of the Hong Kong and Shanghai Banking Corporation, which has its branches in every great commercial center, not excepting Wall street, in New York. There is a huge wooden palace, with the bold inscription "The Siam Electric Light Company," whose managers—it may be said in confidence—made a big failure last year, but who were, by His Majesty's private liberality, most graciously put upon their feet again. There is a regular telegraphic school established in Bangkok, where boys become familiar with Morse's apparatus. Following the main road down-town, an electric tramway equipped by an American company is superseding the horse-cars. At one of the best hotels, or the English or German clubs, one may order a "whisky soda," the great drink of the far East, as temptingly iced as it could be in the best appointed New York club. The ice, a most expensive luxury in this latitude, is provided by the flourishing Ratana ice factory.

After the visitor has seen the country, the people and their manners and customs, and their tendency toward progress, and learned their history and studied their art, he must say that truly the Siamese nation deserves all the attention and sympathy lately bestowed on it by the western world, and that the Siamese have a right to exist as a free and independent people.

While the American or European pioneer need never repent having contributed to the work of civilization in a country so interesting as Siam, there are some serious drawbacks. Siam is not a healthy country, and many a young man full of hopes, and strength, and energy lies buried in the marshy ground of Bangkoks' cemetery, or at some point where he died on his way home when the doctors had sent him off. The water is bad in the city. There are no wells whatever in Bangkok on account of the alluvial formation, and the Meinam water is infected. So the only supply is the rain-water gathered from the roofs in large clay jars or iron tanks. This water is precious, especially during the dry season, and is kept for the use of the cooks. This chief agent in maintain-

ing human life being absent, it is natural that cholera, dysentery, and other diseases should be permanent in Bangkok. But here, too, the government shows a progressive spirit. Engineers have been sent to the Straits settlements, Calcutta, and Bombay to study the best systems for an adequate salubrious water supply for the capital. Systematic filtration of water brought down the river Meinam has been suggested, and also water brought by conduits from the northern mountains. But either system would involve an enormous expense,and the government, not knowing which would really be the better, is still hesitating before making a decision. In addition to the lack of water, the rapid putrefaction of most eatables under the enormous heat must be taken into consideration by every one who thinks of settling in Siam, not to speak of the myriads of ants, mosquitoes, and cockroaches, which are worse plagues than all the tigers and snakes. A few months ago the question was raised of the establishment of a Pasteurian institute. It is earnestly to be hoped that this may be carried out, since few countries have suffered more from outbreaks of cholera and small-pox in proportion to their population. Before Mr. Haffkins or any other Pasteurian disciple visits Bangkok for any such purpose, however, the government will do well, by taking a decisive step on the water question, to strike the evil at the root. But as frequently happens in Oriental matters, though good will and the best intentions may exist, things are often taken by the wrong end.

EFFECTS OF BRITISH SHIP SUBSIDIES.

By Thomas Rhodes.

IT is impossible to say definitely what amount of aid the British government has afforded to national shipping interests. But if the amount was known it would be equally impossible to estimate the effect of such aid with sufficient exactness for the result to be worth serious consideration. The so-called subsidies granted are on record, and so are the successes and failures which attended the undertakings associated with them. All this, however, amounts to nothing. Had the pecuniary support to the steamship companies been given in stricter accordance with the term employed, as the system is at present; had payment for service rendered not been blended and confounded with payment for the supposed or real forwarding of imperial interests,—there would have been data for theorists to conjure with. As it is, the figures would form a very unsatisfactory base to build even a theory upon. It is the old tale of well nigh every inquiry connected with political economy: the circle is "vicious," and arguments *pro* and *con* might be sustained forever. Nothing remains, therefore, but to treat the subject "historically."

It is generally supposed that British shipping interests have received from time to time very substantial government support, and there is no doubt that, on certain occasions, the government has had this end in view when entering into arrangements with ship-owners. But care must be taken to distinguish between individual and general interests. It is possible for the government to help one or more individual ship-owners to fortune by means of subsidies and, by so doing, to stifle all other efforts which, if given a fair field, and not overmatched by the government grant, would establish a business founded on sound, independent initiative and energy. A policy of this kind is—to deal with single factors—equivalent to bolstering up one individual in order to down competition at home and provoke it from abroad. For example, A, B, C, and D are ship-owners, A and B of one nationality, C and D of another. A obtains a subsidy from his government. It necessarily follows that, with this circumstance to back up their application, either C or D is sure to obtain similar aid from their

government. The result is that internationally the two efforts are nugatory, while at home each government lends itself to crushing one of its own subjects in order to enrich another and render him less alert in his business, and to hold back the development which competition engenders.

On this account I hold that the British government has afforded no real aid to the shipping interests of the country until quite recently, and to a very slight extent. For the purpose of a cursory examination of the question we need go back no further than the inauguration of the transatlantic steam mail-service in 1840. And as that service forms as good an exemplar as any, we may, without great loss, restrict ourselves to it.

In 1838 the possibility of crossing the north Atlantic under steam alone had been satisfactorily demonstrated. In the year following, Mr. (afterwards Sir Samuel) Cunard, a Canadian of the Napoleonic type,—of which, by the way, there are still some good specimens,—came to England and induced two of the leading steamship-owners of the day to join him in an offer to the British Admiralty to undertake a regular steam mail-service between England and North America. Of the progress of Mr. Cunard's negotiations there is, I believe, no record. The outcome was a contract signed July 4, 1839, for a fortnightly service between Liverpool and Halifax "by means of a sufficient number of good, substantial, and efficient steam-vessels—furnished with engines of not less than 300 horses power," with branch connecting services between Pictou and Quebec and Halifax and Boston. The contract was for a period of seven years, and the subsidy £60,000 per annum. It must be borne in mind that in those days mail contracts were matters controlled by the Admiralty and not the Post-office. According to O'Connell's well-known saying, "a fine speech is a very good thing, but the verdict is *the* thing." Mr. Cunard was a consummate negotiator. His correspondence with the various government departments is generally inconsequent and entirely innocent of logic, but he invariably carried his point. One sees the same phenomenon in law courts. To the amazement of his client counsel will throw overboard the carefully rivetted evidence in his brief and set out upon a sentimental speech utterly devoid of argument—and win his case. He knows his men. Accordingly we find Mr. Cunard sailing pleasantly along to the year 1868, the subsidy being increased to £80,000 in 1841, and to £145,000 in 1848, in return for an increase in the horse-power to 400 and a service to New York,

making forty-four transatlantic voyages in all per annum; and subsequently declining again to £80,000.

Now, while approving the course adopted by Mr. Cunard and admiring his success in it, I nevertheless maintain his State-created ascendency to have been distinctly prejudicial to the natural development of British shipping within the sphere of his activity. I go further and assert that the Cunard line has had since to pay for the unsound traditions it inherited from this era of unnatural, and therefore unsound, development. Lest it should be thought there is something inconsistent in approving a course and at the same time accounting it prejudicial, I will explain how the two might be reconciled. Let a ship-owner get all he can, but, if he wishes his line to live and prosper, let him distinguish between undeniable trade earnings and the proceeds of "diplomacy."

Various attempts were made to fight through this monopoly, but without success until Mr. Inman became formidable enough to compel the Cunard company to admit him to share in it, in 1869. Among the petitions presented to Parliament in this connection were two in 1846 from the directors of the Great Western Steamship Company, in which, after praying they might be allowed to tender for any new business, they call attention to the fact that, though they were the first to build and send to sea a steamship for the purpose of solving the disputed problem of transatlantic steam navigation, and that the establishment of transatlantic steam service was due to their enterprise,—notwithstanding these important circumstances, which ought in their opinion to have secured favorable consideration for their line, the government "was seemingly in league with their competitors to crush them." More instructive still is a somewhat voluminous parliamentary return, in 1853, containing copies of the correspondence relating to an application on behalf of the promoters of the London, Liverpool, and New York North American Screw Steamship Company for the grant of a royal charter of incorporation,—*i. e.*, for permission to form a company with limited liability. The attempt was held up as an iniquity. Mr. Cunard declared it would be an injustice to set up a company possessing the advantage of limited liability to compete with those who had embarked their own capital in the trade, adding, with his naïve contempt of logic and ingenuous appraisement of official intelligence, "because these companies are frequently got up by persons who know nothing of the business—and who will be aware that individuals cannot stand out against them with their

limited liability." Mr. Cunard was, however, on this occasion, either not alone in his opinion or without influence, for, incredible as it may appear to-day, petitions poured in upon the government from many of the chief commercial centers against the gross injustice of the contemplated charter.

This particular case is so characteristic as to be worth a little special attention. The promoters of the proposed company asked for nothing but permission to come into existence. They backed up their request by pointing out that in April, 1851, Mr. Cunard had stated that the property belonging to himself and partners represented an accumulation of undivided profits amounting to a million sterling, that at the time (in 1852) the Cunard line was receiving no less than £186,000 per annum, and consequently "it may be easily conceived how much more rapidly their accumulation of profit must be going on and their power of crushing opposition be increased." The Board of Trade refused to grant the charter on the ground that, "looking to the amount of private enterprise already engaged in the carrying trade by means of screw steamships between this country and the United States of North America, their Lordships are unable," etc. And their Lordships had the subjoined figures when they came to this decision:

SHIPS CLEARED FOR NEW YORK.

At London:	United States sailing ships.....	68,074 tons
	British sailing ships.....	931 tons.
	[No steamer of either country.]	
At Liverpool:	United States sailing ships.....	312,798 tons.
	British sailing ships.....	37,074 tons.
	United States steam ships	37,560 tons.
	British steam ships.....	32,170 tons.

In 1853 the governor of Canada wrote to the home government protesting that Canada had to pay a large subsidy for a line of steamers running into the St. Lawrence simply because Her Majesty's government gave a large bounty (?) to a line running to foreign ports. Again, in 1859, in a memorial from the Legislative Council and Commons of Canada occurs the following: ("We learn with regret that it has pleased your Majesty's government to renew the contract with the Cunard company without an opportunity having been afforded to the government of Canada to urge such arrangements as would have been conducive to the prosperity of the colony.") In 1857, long before the expiration of his existing

contract, Mr. Cunard applied for an extension on the plea that the Americans were about to build much bigger and more powerful steamers, and he must do likewise or submit to being extinguished by them. He could not, however, he said, afford to build the class of vessel required to meet the threatened competition unless his subsidy was guaranteed to him for a term of five years beyond his existing contract. "Such powerful and expensive ships," he added, "as are required for this service are totally valueless at the termination of the contract—the *Persia* consumes upwards of 160 tons of coal a day—the wear and tear and other things are expensive in like proportion. (No other employment would support such frightful expenditure." The Lords of the Admiralty recommended the Treasury to accept the proposition, but the Postmaster General, the Duke of Argyll, thought otherwise, and his letter to the Treasury might have been written to-day, so sound and in a sense prophetic are the principles he lays down.) His objections were, in fact, unanswerable. The Admiralty replied by declaring it to be the Postmaster General's business to see to the conveyance of the mails, theirs to decide the class of steamers needed. The Treasury declined, however, to accede to Mr. Cunard's request. But he knew his men, persevered, and within eighteen months got what he wanted. "The Americans," he wrote, "are extending their mail-service over almost every navigable part of the world and will, in many places, have the entire monopoly. They would have had it on the Atlantic long since, if I had not, at great risk and danger, taken up the decided position I did." And so the Treasury, with the unanswerable logic of the Duke of Argyll's letter before them, and in direct opposition to the report of a committee of the House of Commons, in their own words "arrived at the opinion that an extension of this contract may without further delay be conceded as a matter of great public importance."

I am unfortunately unable to track closely the progress of American steam shipping. For the years previous to 1860 no figures are available, and, more regrettable still, none are given for the years between 1860 and 1870, except under the head of tonnage sold to foreigners. Thus what would have been, had not the civil war occurred, can only be surmised. For my own part I believe the question of competition for the United States was already settled for many years to come, and that the war merely hastened and emphasized the inevitable. (The substitution of iron for wood in construction and the splendid opportunities offered to capital by

domestic undertakings in the States after the war were preponderating influences in favor of British shipping interests.

TONNAGE OF STEAM VESSELS BELONGING TO—

	United Kingdom.	United States, Registered for over sea.
In 1840	87,539	4,155
In 1850	167,698	44,942
In 1860	452,352	97,296
In 1870	1,111,375	192,544
In 1875	1,943,197	191,689
In 1890	5,037,666	197,630

If we regard iron as introduced in 1850 (Inman liner *City of Glasgow*), it will be seen that the rate of progression was virtually the same from that year before and during the war, and that it has practically stood still ever since.

The figures of the tonnage sold to foreigners by the United States shipbuilders are even more striking,* viz.:

In 1850	13,468	In 1865	133,832
In 1860	17,418	In 1866	22,117
In 1861	26,649	In 1867	9,088
In 1862	117,756	In 1868	13,757
In 1863	222,199	In 1890	13,322
In 1864	300,865		

In maintaining the civil war to have been a minor cause I am aware I am at variance with high authorities. The *Times*, for instance, on the occasion of the transfer of the *City of Paris* and the *City of New York* to the American flag, observed: "There was a time when the shipping industry was one of the most flourishing in America, and when vessels built and owned in that country played a prominent part in the carrying trade of the globe. The fabric of prosperity built upon this basis, however, fell down like a house of cards when struck by the shattering blow of the civil war." Yet I venture to believe that the true causes were those I have mentioned.

In 1860 an act of Parliament transferred to the Postmaster General the powers up to that date exercised by the Admiralty as regards the conveyance of mails by sea, and thenceforth an entire absence of sentiment is noticeable in official dealing with ship-owners. Meanwhile the commercial community was hastening the downfall of the fixed subsidy by making its voice heard in favor of sending a mail by the German steamers calling at Southampton, and for

*The years for which the larger figures appear in the table comprise the period of the civil war.

the last year of the Cunard monopoly the amounts paid were: Cunard, £80,000 by fixed subsidy; Inman, £22,161; North German Lloyd, £9504: Hamburg-American, £3343 by weight of mails carried. By the next year Mr. Inman had asserted his claim to participate in the subsidy, which accordingly stood: Cunard, £70,000 for a service twice a week; Inman, £35,000 for a service once a week, the contracts being for seven years,—namely, until 1876. The Hamburg-American dropped out of the arrangement, but the North German Lloyd continued to carry a mail which was paid for by weight throughout, except for one brief period. But though the system of subsidies was continued it was by now universally condemned. Hardly were the last contracts signed when a select committee was appointed to go thoroughly into the question, and its report, issued in 1869, recommended that the contracts entered into with the Cunard and Inman companies should be disapproved, compensation being made if necessary, there being no longer any sufficient reason for fixed subsidies for a term of years. Bnt the government did not feel competent to cope with the situation the adoption of this recommendation would have brought about, and it was not acted upon.

In 1870 the White Star line appeared upon the scene, and by 1874 the *Britannic* and *Germanic* were making a reputation for fast passages. With another string to his bow the Postmaster General was enabled in 1877 to apply the principle of payment by weight of mail matter carried universally, the great English companies receiving 4*s* per pound for letters and 4*d* for printed matter, and the North German Lloyd 2*s* 4*d* and 2*s* respectively. About ten years later the then Postmaster General, the late Mr. Fawcett, made a serious effort to reduce the rate of payment to the minimum fixed at the Berne Convention, and for a short time the great English companies carried no outward mails, and lawsuits were in the air. Eventually an arrangement was come to in 1887, which is still subsisting, and by which the Cunard and White Star companies carry all mails except specially-addressed letters, and receive payment at the rate of 3*s* per pound for letters and 3*d* for printed matter, closed and transit mails being paid at special low rates. These contracts are terminable by twelve months' notice on either side.

Thus to-day there is as near an approach to free trade in the carriage of the British mails to the United States as can reasonably be expected, considering "the nature of man and condition of things." The men at the head of the great transatlantic lines

would be more than human, and unquestionably remiss in their duty to their shareholders, were they to accept a penny less than their position enables them to demand. They receive nearly double the Convention rate of *1s* 9½*d*, because they are strong enough to say "that is our price." It is true every one is now at liberty to send his correspondence by whatever steamer he prefers. But the correspondence of the merchants, who make all the ado in these affairs, forms an insignificant percentage of the whole. The bulk of all mails is contributed by people who would never dream of troubling as to how a letter is to reach its destination.

A splendid testimony to unaided effort exists in the White Star Company and also in the North German Lloyd, neither of whom has received a penny of subsidy; but any instructive financial comparison between them and the older line is out of the question, owing to the break in the constitution of the last when it was formed into a joint stock company. I should say too that the free trader would find a strong argument in his favor in the position of the French on the north Atlantic. With a bounty on construction amounting to about £25,000 on a vessel like the *Bretagne* and substantial navigation bounties (on a complicated scale ranging from *1fr* 50*c* per ton per 1000 miles to French-built ships in the first year, *1fr* 45*c* in the second, and so on for thirty years, and half if foreign-built)—with every American, so to speak, making for Paris,—they have but a single great line, running one steamer a week.

At the outset I remarked that the British government has afforded no real aid to the shipping interests of the country—until quite recently and to a very slight extent. In 1885 there was a war "scare," and some £600,000 was expended in retaining the services of several fast merchant steamers. Experts declared these to be of very doubtful utility, owing to the exposed position of their machinery and general unsuitableness of their internal disposition. Two years later, when negotiating the mail contract, Mr. Ismay pointed out to the government how the objection of the experts could be met and a supply of mercantile cruisers, suitable in point of speed and construction to be included in the reserve fleet of the navy, made always available. The suggestion was put into definite form by an offer on the part of the White Star line to build two vessels under Admiralty supervision which should be at the disposal of the government at any time either for

purchase or charter at fixed prices and rates, the Admiralty to pay in return an annual retaining fee of 15*s* per ton for at least five years, to be advanced to 20*s* for any part of that period during which the company should not hold the contract for the American mail. Mr. Ismay's suggestion was accepted as sound and reasonable, the *Teutonic* and the *Majestic* were laid down, and the Admiralty announced their readiness to grant the same subvention to any British steamship company under corresponding conditions. Not only was it paid to the Cunard company on account of the *Umbria* and *Etruria*, but also to the Inman and International company on behalf of the *City of Paris* and *City of New York* so long as they continued under the British flag, although they were not built in accordance with the conditions implied in the letter on the subject from the Admiralty to the Treasury.

Given equality in other respects, government aid must of course turn the scale. A much larger sum, however, than any government would be likely to give would be needed to place an incompetently managed association on a level with those famous lines whose house-flags are the pride of their country. The talents required for the successful direction of a great mail-line are not unlike those which go to make a successful commander in the field; grasp of detail, confidence in the settled "plan of campaign" in the face of untoward events, reliance in the estimate formed of the capacity of subordinates and courage to give them a corresponding freedom of action in their departments, and so on. If it is permissible, without offending by a seeming impertinence, I would parody the Duke of Wellington's reply to one who remarked that when in India the Duke's chief occupation appeared to be procuring bullocks and rice. The Duke replied it was so, because if he had the wherewith to feed them he could get soldiers, and with soldiers he could secure victory. I would say, see to your beef and coffee, see they are good, not merely when they go on board, but when passengers take them, and you will have passengers, and with passengers dividends. In years past it was safety before all things; safety we have; the demand to-day is for comfort.

SCIENCE AND SPORT IN MODEL YACHTING.

By Frederick R. Burton.

NO European traveler who spends any time in Kensington can fail to be struck with the number of elaborate toy sail boats that are carried along the streets by men. Few of these boats are less than three feet in length, and they are always completely rigged, beautifully painted, and finished in every detail. Jumping at conclusions, one imagines a small army of boys made happy by indulgent fathers who have given them unusually attractive and expensive playthings; but though many a small boy launches his ship on the ponds in London's parks, these boats, carried as gingerly as if they were made of glass, are not for the amusement of children; they are for the recreation and entertainment of elder people, furnishing the means to a sport unknown in America, and an incentive to study in construction and navigation that stands quite apart from other problems that interest the marine world.

At first blush it seems ludicrous that grown men should spend time and money in sailing miniature yachts upon a sheet of water but a few acres in extent; extraordinary that, instead of playing with their toys on some remote, sequestered pond where none but birds and cattle could see, they choose the most public spot available in London, and there disport themselves with all the eagerness of children, with more than the devotion of boys to their game, with all the intelligence and keenness of observation that characterize the sailing of forty-footers in great regattas. But there they are, strange as it seems to the unfamiliar spectator, carefully setting the sails of their tiny craft, pushing them out upon the water, running along the bank with sticks ready to poke the boats away should the wind drive them to the shore, excited and anxious concerning the speed and behavior of the little vessels, unmindful of the watching crowds save as a victorious skipper may feel a glow at his heart when hand-clapping and cheers proclaim the esteem in which crowds always hold the winner. Such a scene may be witnessed at the Round Pond, Kensington Gardens, every pleasant secular day from April 1 to November 1, and on every Thursday there is a formal regatta for prizes. On other days scratch races are sailed, or owners experiment with their

boats, trying the effect of changes in rigging, different sizes of sails, testing the capacity to beat to windward, and so on. Now and again among these ancient playfellows there may be seen an inventor, or manufacturer of marine toys, making experiments with his new creations, but most of the navigators are men whose fortunes remove them far from the currents of commerce.

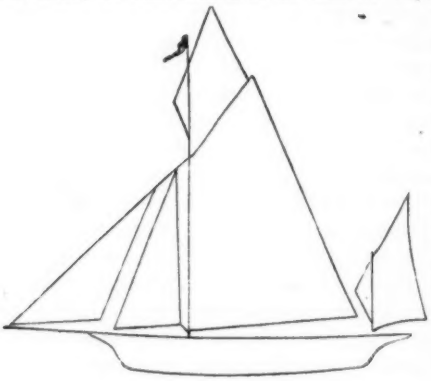


FIG. 1.
Model Yacht, old style.

Old men—that is, men whose childhood is in the hazy past—play at sailing toy boats? Bless the stars! yes; and more than that, they form clubs for the purpose, as the charter of one club has it, of "the improvement of model yacht building, and the encouragement of model yacht sailing." There are nearly a hundred such clubs in England, some with entire buildings devoted to their use, others occupying suites of rooms; there is even a little periodical published in the interests of model yachting, in which may be found the records of races, news concerning the latest boats, novel ideas for construction, technical discussions as to sail measurements, depth of keel, shape of hull, etc.

The Round Pond, or Basin, in Kensington Gardens, is the principal place in Great Britain for model yacht sailing. Three organizations have their headquarters in club houses near by, the most important of which is the "London Model Yacht Club." See with what impressiveness and dignity this apparently childish sport is conducted; the following list of officers is copied from a little book containing the constitution, sailing rules, etc., of the London club:

FIG. 2.
Section of hull amid ships, old style.

President, Prince Batthyany-Strattman; Vice-President, Sir Algernon Borthwick, Bart., M. P.; Commodore, T. F. Drinan, Esq.; Vice-Commodore, Capt. R. Methven; Captain, S. E. Johnson, Esq.; Hon. Secretary, Walter Greenhill, Esq.

The entrance fee to this club is ten shillings, and the annual dues a sovereign. The constitution is much like that of other clubs devoted to special objects, but to provide against discord discussion of religious or political topics is expressly forbidden. Another clause introduces an odd bit of parliamentary procedure, and reminds one of the international supreme court recently suggested by Mr. Labouchere; in case of a tie, the chairman has a casting vote in addition to his own. The walls of the club house are covered with pictures of model yachts of various designs, and with drawings and plans. The diagrams that accompany this article were made from complete yachts set up in cabinets and on tables in the club rooms.

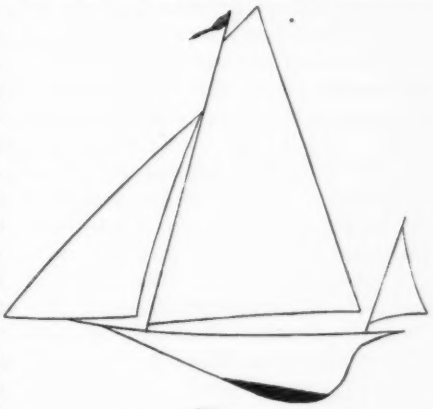


FIG. 3.
Model Yacht, present shape.

It need not be said that the conditions that confront the builder of model yachts differ considerably from those with which Mr. Beaver Webb or the late Mr. Burgess had to deal. In the case of the miniature craft the conditions may differ so materially in different localities that a model eminently serviceable for the Round Pond might be second rate at Victoria Park or at a pond in Liverpool. In general, however, the Bermuda yawl, as shown in Figure 3 (section of hull, Figure 4) is the design now in vogue in Great Britain. Slight variations appear according to local conditions, but the variations figure more in the ballasting and in devices for steering than in the "lines." Some of the yachts in the London Club fleet have ingenious rudders adjusted with movable weights so as to work automatically. These devices are the inventions of members, and it should be said that many of the members make their own yachts from keel to pennant, including even the nickel or silver plating of the metal fittings.

FIG. 4.
Section of hull amidships, present style.

The Round Pond is an artificial basin of water 250 yards in diameter. It was constructed as an ornamental feature of the park surrounding Kensington palace, once a favorite residence of royalty. Queen Victoria was born there. The palace, partially concealed by trees and shrubbery, stands a short distance to the west of the pond. Model yachtsmen have to contend against two peculiarities in sailing their boats there. One is the variableness of the wind due to the several avenues lined by great trees that lie near the borders of the pond. Another is the presence of weeds in the water. The bottom of the pond, five feet below the surface at the greatest depth, is not concreted, and, though the water was drawn off and the basin thoroughly cleaned seven years ago, the weeds have since appeared in as great profusion as ever. Under the circumstances, therefore, it requires no little skill to set the sails of a model yacht so that the craft may avoid obstructions and not be unduly influenced by erratic whiffs of air. Under proper conditions the boats will jibe naturally, and one of the objects of the navigator is to start his yacht upon such a course that she will jibe at the right time. It is quite the regular thing, however, when not sailing directly before the wind, to set the course for a point on shore part way between the start and finish stations. The boat once started, the navigator runs along the shore to the point indicated and waits, stick in hand, for the craft to arrive. This stick must not be longer than four feet, and in using it the navigator must not step into the water. Moreover, when he turns his boat, he must not walk in the same direction in which the boat is sailing. This is to prevent giving the boat a push, the only push allowed being one by hand at the starting station.

The following extract from one of the sailing rules gives a clearer idea of the way model yachts are raced than a column of description :

" * * * If in running a boat comes to the shore, she may be turned off with the stick placed against the bowsprit, or forward gear outboard. When in beating a model comes to the shore, she shall be put fairly about by turning her head off with a stick placed on that side *only* of the bowsprit or gear outboard forward which is to leeward as she comes in, steadying her round by placing the stick against that side *only* of the boom or gear outward aft which is to leeward as she goes out till her sails are full."

And when the boat is well about and speeding on the new tack, away scampers the ancient navigator to the other side of the pond

to repeat the operation with his stick, all anxiety to get his boat across the finish line ahead of her rivals.

Races are sailed on the tournament system with a somewhat complicated method of counting. For instance, the boat arriving first within the winning boundaries after a beat to windward counts three to her score. The boat first in in a run (or reach) counts two. Then there are handicap penalties in the various classes, for the boats are classified according to measurements as strictly as are those that carry their skippers on board ; and this recalls another pleasing feature of this gentle sport—classification is fixed in tons ! Thus, there are 10-ton boats, 15-ton, and so on. Handicapping is effected by scoring points against winners of first prizes, three points "off" in subsequent races for the first prize, two more for the second, and one point additional for each succeeding first prize. These and similar other penalties stand only throughout a single season. With the beginning of a new yachting year, the boats start unencumbered by handicaps.

Round Pond became the leading water for model yachting in 1884, when the London club was organized. At that time the boats were of the pattern shown in Figure 1, section of hull, Figure 2. The evolution to the present style, Figures 3 and 4, has been gradual, every year bringing forward several experimental changes, some of which were adopted. It will be observed that the number and shape of the sails has been reduced, the mast set much further forward, the proportions and shape of the hull radically modified. Enthusiasts with ideas of their own frequently bring new models to Kensington to sail against the crack flyers of the London club. Not long ago an Australian appeared with his challenge and a model of unusual build. His name was Stubbing, and he came from Moor Park, Sydney. One feature of his craft was a fin running fore and aft, sunk in a groove in the keel. He failed to win a race on the Round Pond, but he was victorious over all the clubs against which he sailed in the northern counties of the kingdom.

Inasmuch as this quaint sport requires skill and no small degree of scientific study, though applied to small things, there seems to be no good reason why it should not be adopted in America. It supplies a picturesque element to public parks, and is fascinating to spectators and navigators alike. Here are some figures that will be intelligible to yachtsmen and interesting to any who may like to try their hands at building model yachts. According to the London club measurements, a boat 36 inches in length on

the load water line should have a sail area of 2500 square inches to make its rating 15 tons. The sail area decreases gradually with the length on the load water line until it becomes 2000 for a craft of 45 inches. This is the rule for determining whether a boat shall be rated as 15-ton or first class: multiply the length on load water line by the sail area and divide by 6000. Thus—l. w. l. 45 × S. A. 2000 = 90,000; divided by 6000 = 15. Rule for second class, or ten-ton: length on load water line added to beam, squared, multiplied by beam, and divided by 1730, or, expressed by formula,

$$\frac{(\text{l. w. l.} + \text{B})^2 \times \text{B}}{1730} = \text{tonnage.}$$

The beam of a 10-ton boat, l. w. l. 36, should be $8\frac{5}{8}$ inches, the beam in this class gradually decreasing with the increase of length until it becomes l. w. l. $42\frac{1}{2}$, beam, 7 inches.

There have been many differences of opinion between British and American yachtsmen on the subject of measurements and classifications, and unbounded argument relative to the merits of various designs for racing craft. It is just possible that there may be valuable suggestions in the ideas practically applied by the English gentlemen in the construction and sailing of their miniature yachts. Three striking characteristics of model yachts are shown in Figure 3: great draught; large sail area; and the extreme forward position of the mast. The first and third of these features make the second possible. In ocean yachts large sail area is a desideratum to be obtained with as little displacement as possible, due attention being paid, of course, to stability and facility in handling the boat. Without regard to how this is obtained in the great yachts it will be observed that in the London model the hull slants slowly upward from the extreme depth aft until it meets the deck line in an acute angle forward. Boatbuilders will see that this device keeps the center of gravity and the center of buoyancy in relatively correct positions, while displacement is not increased by increased draught. It must be left to designers to decide whether such lines as are indicated in Figure 3 would be practicable for a deep-water racer, but here is a striking and suggestive comparison: the famous *Puritan*, conqueror of the *Genesta* in 1884 in the race for the America cup, carried sails of 8000 square feet (approximate) area. Her style of rigging was very different and more elaborate than that applied to models, but, if the *Puritan* had used the rig indicated, she could not have carried nearly so much sail. This may be shown by a simple proportion. Take

a 40-inch model with a sail area of 2250; for the purposes of comparison it will not be necessary to reduce the *Puritan's* sail area to inches; the proportion would, therefore, be expressed in terms of length to sail area thus:

$$40 : 2250 : : x : 8000.$$

This reduced shows that a boat yawl-rigged to carry 8000 square feet of sail would have to be more than 142 feet long on the load water line.

The question of the relative efficacy of rigs, etc., becomes very complicated. The *Puritan* with its sloop rig was less than 90 feet on the load water line, but there is certainly something worth studying in the effectiveness and simplicity of the yawl as shown in the model. Moreover, American ingenuity might readily discover a design for model yachts founded on our accepted lines that would outsail the most be-medaled craft that ever cut across the Round Pond. The establishment of such a sport as has been described could not but be valuable in an educational way, for it would furnish an incentive to the study of boatbuilding to those who are prevented by circumstances from observing the operations in the great shipyards and the studios of eminent designers. It costs much to test a theory with an ocean yacht; and for this reason, probably, boat building has always made progress more by observation after construction than by scientific research in advance. Model yachts are expensive as playthings, but as models for the study of larger craft they would put the study of construction within the reach of many bright minds whose possible inventions and discoveries are now unthought of and impossible. And as to the sport I cannot see that there is anything more undignified in racing toy boats across a pond than in knocking small balls about on a green table.

THE CAMEL AS A FREIGHT-CARRIER IN AUSTRALIA.

By Edmund Mitchell, A. M.

IN the engineering profession transportation is a factor only inferior in importance to invention and construction. The most perfect mining plant, for example, is useless unless the machinery can be carried to the field of operations and the products resulting from its employment brought back to the markets of the world. To-day the railroad holds undisputed empire on land among transporting agencies. In America it has driven the bullock-teams from the plains of Utah and, in large part, the steamboats from the broad waters of the Mississippi. But there are still territories in which the old methods of transport have not lost their usefulness. In this paper I propose to show how the most ancient form of land transportation is being profitably employed in the most recently settled country in the world. I refer to the camel caravan and to Australia. The work that the camels are doing in the Australian colonies, in connection with exploratory and survey expeditions, in opening up new pastoral country, and in facilitating mining operations in arid regions, is simply invaluable.

It happens that so late as December last I was detailed to make a special investigation into the camel question in Australia. In the course of my inquiries I traveled nearly 2000 miles; visited the quarantine station at Port Augusta, in the colony of South Australia, where the recently-imported animals were graduating for a clean bill of health prior to being distributed over the interior; interviewed the leading Asiatics engaged in the import enterprise; conversed with Sir Thomas Elder and Mr. Phillipson, the manager of Beltana sheep-station,—the pioneer Englishmen in opening up the new industry; secured from Mr. David Lindsay, leader of the recent Elder exploration expedition, autograph excerpts from his diary bearing upon endurance shown by camels traversing the great Australian desert; saw the loading and starting of caravans for the far back blocks; and mingled freely with the swarthy Pathan drivers who have been imported with the animals and are adepts at their management.

CAMELS TRAVELING OVERLAND IN AUSTRALIA, WITH SUPPLIES.

The facts I have to state will, I venture to think, be all the more interesting inasmuch as a similar experiment appears to have been made in the United States with unsuccessful results. "Camels running wild in Arizona and being hunted and killed by the settlers to prevent their stampeding the stock in the territory,"—this was an item of intelligence that I read lately in an American newspaper with interest not unmingled with surprise. I am not in full possession of the facts, but I believe the camels in Arizona above referred to were turned loose about three years ago with the idea that they should become naturally acclimatized, multiply their kind, and prove in course of time a useful addition to the fauna of the country. From the mere turning loose of the camels, which in other parts of the world thrive and breed in the domesticated state, I should infer that the experiment of utilizing "the ship of the desert" in Arizona had proved a failure. The similar venture in Australia has had widely different results, and this article may serve a useful purpose in enabling those who have interested themselves in the Arizona experiment to discover the difference in original conditions or in management that has led to failure in the one case and to success in the other.

So far back as the "sixties," Sir Thomas Elder, who has been one of the most far-seeing, courageous, and liberal-handed men in Australia in introducing thoroughbred horses and valuable breeds of cattle and sheep, made the first experiment in the importation of camels. The venture proved only a qualified success, for heavy financial losses were incurred through a large proportion of the animals dying, soon after their arrival, from a virulent form of mange. However, the survivors of the original herd introduced became thoroughly acclimatized, and have continued to do good work at and around Beltana Station, of which Sir Thomas is chief proprietor. Moreover, they have bred freely, and the young stock have shown themselves in every respect superior to their progenitors, thereby proving the suitability of the soil and climate for the camel race. This last fact, aided by a variety of circumstances, has caused renewed attention to the camel question during the past decade, and the importation of further drafts is now going on upon an extensive scale.

Among the conducing causes referred to is the discovery of water in far-back regions and the progress made in artesian boring. This has resulted in a country formerly deemed useless being opened up for pastoral occupation. But this last achievement has

PASTORAL COMMISSION ON CAMELS PASSING LUNKE RUIN.

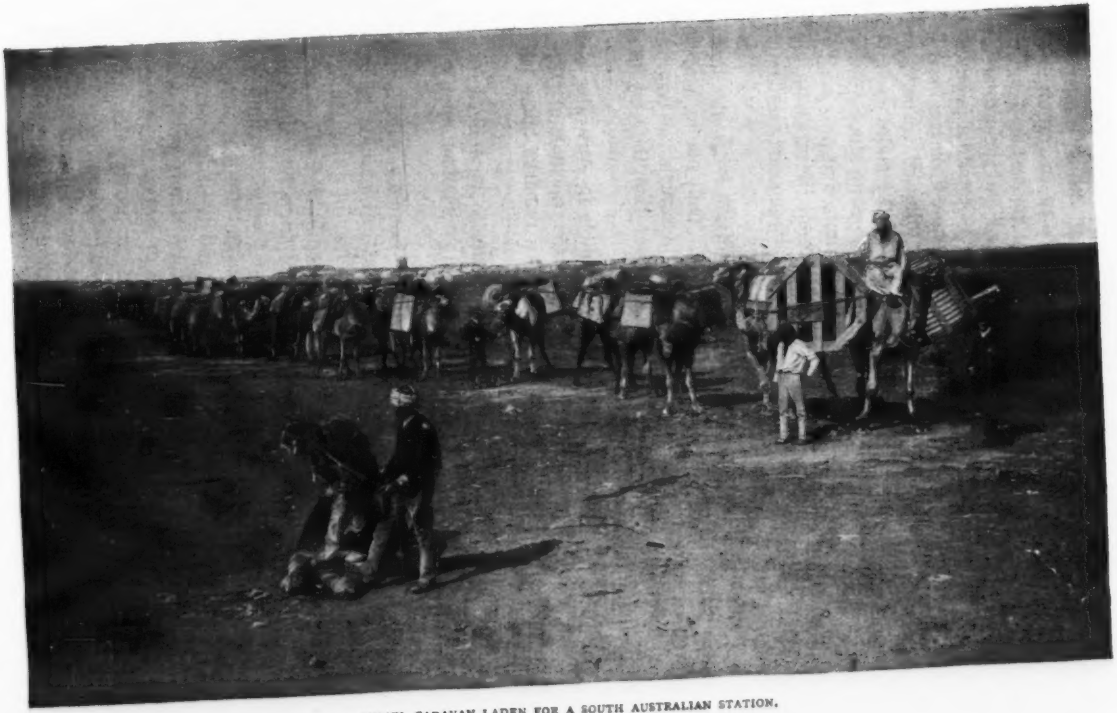
been rendered possible solely by the use of camel transport, for there are no railways and no possibility of making railways pay through these vast unsettled tracts, and furthermore there are absolutely arid areas intervening across which bullock teams and horses cannot travel. The only means therefore by which supplies can be taken to the settlers and their wool produce brought to the ports of shipment is camel transportation. A second, though a minor cause is that even in districts where there is no great stretch of waterless country the bullock-teams which have heretofore conducted the necessary traffic are in the hands of one of the strongest trade-unions in Australia, and the men controlling the labor organizations have on many occasions utilized the carriers as an all-powerful lever to extort terms from the pastoralists by proclaiming a boycott against the stations. This has impelled the wool growers to look around for means to render themselves independent of the bullock carriers, and in consequence a number of them have joined in the importation of camels and will for the future utilize camel caravans in country formerly traversed by bullocks. A third stimulating factor has been the discovery of rich gold reefs in the interior, the machinery for developing which can only be got to the fields by means of camels. Hence the renewed

activity in the importation of the hump-backed animals, which are now represented by thousands where less than five years ago there were only hundreds.

To give an idea of the magnitude of the business, I may mention that in December last there were 500 camels undergoing the three months' regulation period of quarantine at Port Augusta, further drafts of 1000 were on their way to the same port, and orders for the purchase of still another 1000 were being executed in Rajputana, Kattywar, Beluchistan, and Afghanistan, whence the supplies of camels for Australia have nearly all been drawn. Contracts have also been signed for the introduction of still further drafts. In December it was computed that there were 3500 camels then actually landed in Australia, so that it will be seen that during the next two years that number will be increased up to at least between 6000 and 7000. All the camels in Australia are of the one-humped species, this having been proved to be the more suitable kind for the requirements of the country.

The disease known as the camel mange, ever-present among the beasts when in northwest India, seems to develop into an aggravated form when they first land in a new country. However, observation and veterinary skill are stamping out the scourge in Australia, and after the animals get over the initial attack careful attention secures them from further trouble from this source. No animal is allowed out of quarantine until it has undergone the test of three months' residence and has been subjected to the most careful examination. The camels at work throughout the country are absolutely free from the disease; hence the paramount necessity of blocking the infected animals.

When the camel is once acclimatized, all that is needed is careful tending to safe-guard it from any recurrence of the complaint. The animals thrive wonderfully upon the natural shrubs of Australia,—salt-bush, wattle, mulga, acacia, and other varieties. They wax fat especially upon salt-bush,—a plant that is likewise eagerly devoured by cattle, sheep, and ostriches. The eucalyptus trees also supply them with suitable provender, and they are tall enough to reach feed of this class which horses and bullocks, even if they would eat it, could not crop. Curiously enough, the camel never eats grass unless absolutely driven to do so by hunger; the foliage of shrubs and trees appears to be its natural provender. I have said, incidentally, that the young stock bred in Australia are superior in all respects to their parents. The reason for this is not hard to



CAMEL CARAVAN LADEN FOR A SOUTH AUSTRALIAN STATION.

find. In India and Afghanistan indiscriminate breeding is invariably the order of the day. The oriental mind shrinks almost with horror from the application of the principle of castration to any species of domesticated animal. Hence the poorest and weakest sires get stock as often as the large-framed and the strong. In Australia, where the breeding of sheep so as to add a penny per pound to the value of the wool upon a whole flock has been reduced to a science, a very different plan is followed. The camel sires are carefully selected, and the residue of the males castrated in early youth. Hence it results that the young stock grow up larger in frame, sounder in wind and in limb, and possessed of greater weight-carrying capacity than the animals originally imported. An Afghan importer named Abdul Wade said in the course of conversation with me at Port Augusta :

"When I go to buy camels in Afghanistan for Australia, of every twenty I see, nineteen are no good. Only one in a score is worth taking away. Here, every one of the camels you Englishmen breed is good, and many of them are finer than the very best to be found in all Asia."

This Abdul Wade is a large owner of camels in Australia, and holds a number of big station contracts for the transport of stores and wool. So I drove the point of his own remarks home with this query :

" Then, as you admit the excellent results to be derived from the principle of selection, I presume you will yourself act upon it in the management of your camels ? "

For a moment his brow clouded, and I could see the innate prejudice of his race struggling with the practical learning he had acquired in a new country. But Abdul is a man of enlightenment and of broad-minded views, and his face speedily cleared. " Yes," he replied, after this show of momentary hesitation, " I admit you Englishmen are right, and I will follow your plan of breeding."

The young camel can be used for pack- and draught-work at three years of age. It grows up to ten years, and lives forty years or more, working all the while. Indeed, constant steady work is essential to their health, and, unlike bullocks or horses, they never require to be turned out for a spell, this, indeed, proving detrimental to their condition. The value of the camel varies with the sex and the qualifications of the animal. A fleet-footed dromedary, or riding camel, will fetch up to $500. A good average pack- or draught-beast is worth from $200 to $250. The cow is always

PASTORAL ROYAL COMMISSION ON THEIR JOURNEY ON CAMELS IN SOUTH AUSTRALIA.

PASTORAL COMMISSION IN NIGHT CAMP.

valued at from $25 to $30 more than the bull or the bullock, insomuch as the yearling calf at her foot is worth not less than $75.

It will already have been gathered that the camel is utilized in Australia for three distinct purposes,—as a pack-, draught-, or riding-animal. Most of them are used as pack-carriers, and a fair average load is 550 to 600 pounds, with which they can travel twenty-five miles a day for two months at a stretch. Individual camels can carry heavier burdens for a shorter spell, and the plan adopted on the march is, when any particular load is necessarily from its nature over-weight, to change that burden day by day, each of the strongest animals taking it in rotation. When the camel is used for draught purposes, he may be driven in a light vehicle in single or double harness. During the hot season, a considerable amount of work is done by the postal authorities in the northern regions of South Australia, mails being collected and delivered by camel buggy. The animals may also be yoked to a wagon in a team of eight or fewer, a high curved pole and a modification of the horse collar being used in this case. The wheels are provided with broad tires, and in this way heavy machinery can be transported over the desert. The riding camel, or dromedary, is used by the police, and also by station-managers when urgent messages have to be

WINNICKE'S DEPOT, MACDONNELL RANGE.

CAMELS IN THE DESERT OAK FOREST, IN SOUTH AUSTRALIA.

sent to the centers of civilization. These fleet animals will traverse over 100 miles per day for a week at a spell, and at an emergency have nearly doubled that record in a single period of twenty-four hours. An offender on horseback fleeing from the police has no chance against a constable mounted upon a dromedary, and the South Australian police have many exciting stories on record of feats of this class performed by members of the force. Government parties engaged in telegraph construction work have with them at one and the same time draught-wagons, pack-camels, and riding-dromedaries. Surveying and exploring parties dispense with the draught animals. The transport of stores and wool to and from the stations is done mostly by pack-camels, the compressed wool bales being made smaller than the usual size, so as to permit of a full load being slung in two equal portions on each side of the beast. For the transport of machinery, furniture, etc., the draught wagon is utilized. Managers of sheep stations also use the single-harness camel buggy to drive around the runs, inspect the stock, and visit the men upon the out-stations.

An overlanding caravan may be composed of twenty, forty, or even up to eighty animals. The headman in charge, if a European, rides upon a dromedary. There is one Afghan attendant for every

SOUTH AUSTRALIAN ABORIGINES SURPRISED BY A CAMEL TRAIN.

eight beasts, and he either walks or rides upon the load carried by one or other of his team. The young camels follow the caravan, and, showing the wonderful hardihood of these creatures, a four days' old calf has been known in Australia to travel twenty miles in a single spell, keeping up with the caravan all the time. These men seem to understand and to be understood by their charges, thoroughly. They speak to them in Pushtoo, the language of the Afghans, and even kiss and fondle them when loading or unloading. The Afghans come to Australia under a three years' contract. Their wages are about $15 per month, nearly all of which they save, as their employer supplies rations and their moderate requirements in the way of clothing, shoes, etc. This frugality in living raises the ire of the white bush-workers and the township storekeepers, and the Afghans are roundly rated at because they take nearly all their earnings out of the country at the expiry of their contracts. But there is another way of looking at the question. Suppose a Pathan camel-driver saves $500 during his three years of service, and takes away with him that amount to his native country, where it serves him as a handsome provision for the rest of his days. The $500 is not lost money to the country, for his labors have added probably ten or twenty times that sum to the wealth of the country in which he has worked. The prejudice, therefore, of the white man against the Pathan is unjust; moreover, it is quite open to the former to enter upon the work and secure ordinary white man's remuneration for his services if he proves himself competent in the management of camels. Indeed, with breeding systematically conducted in Australia and the animals brought up from youth among white men, there is every likelihood of the Pathan driver being eliminated altogether in the near future in favor of the Anglo-Saxon, who, in this line of life as in every other, is sure in the long run to beat his dark-skinned competitor at the latter's own calling.

But to show how necessary it is for the white man to receive instruction at the present stage from the oriental, I have only to cite the nose-peg by which the animal is led. This is an Arab-device, the origin of which is lost in the obscurity of ages; and for the purpose it is intended to serve it is a contrivance of rarest ingenuity. The nose-peg is for all the world like a chess-pawn, and is inserted in the muscle of the nostril, the thicker end within and the point protruding. To the point is attached simply a loop of string, upon which the stout leading rope is fixed. The strength

of the whole arrangement, be it observed, is simply the strength of the loop of string. Any sudden jerk, through fear or anger, breaks that, and the animal is freed from restraint without injury to itself. Its driver can then soon reduce it to obedience again, and a fresh loop of string repairs all the damage done. A ring in the camel's nose would be useless, for the animal, when frightened or enraged, would with a single toss of its long and powerful neck pull it through the flesh and permanently injure itself. The loop of string may seem a very weak medium of control, but, in the case of a camel once broken in, proves adequate to guide the docile animal from one end of the year to the other.

I have referred to the hostility displayed by the bush unionists of Australia to the Pathan camel driver. Perhaps even more bitter is their enmity to the Pathans and Indian Mussulmans of superior class who are at the head of the camel trade. I have already mentioned the name of one of these, Abdul Wade, and his personality is typical and remarkable enough to merit a description in some detail. Olive complexion like that of a Spaniard, sharp clear-cut features, rather prominent nose, keen eye, glistening white teeth, medium height, the firmly-built figure of a mountaineering race, and the natural grace and courtesy untinged with the slightest admixture of servility that distinguish the inhabitants of the north of India from the dwellers on the plains,—such is the portrait of Abdul Wade so far as words can paint it. We met at Port Augusta, and but for his voluminous white turban—the possession of which I envied him under the broiling sun—there was nothing to distinguish him, as regards garb and general appearance, from our party of Englishmen. Abdul's command of English I found to be perfect; and as regards camels he at once became my "guide, philosopher, and friend," and during several days freely communicated to me the results of his experience. Abdul Wade is a native of the Quetta district of Afghanistan. He is not the pioneer Asiatic engaged in the camel traffic, but he early grasped its possibilities. He first landed in Australia with camels fourteen years ago. Now the extent of his operations may be guessed at from the fact that he is at present executing a contract to import 750 animals.

"After you have got out these 750, Abdul," I remarked, "what next?"

"Then," he replied laconically, "I shall go back to Karachi and buy 750 more."

"But I have heard it said, Abdul, that the bullock team carriers have vowed to kill you for spoiling their industry."

"Ah!" he responded, with a smile, "I could not prevent them perhaps killing me, but that won't stop the camels."

There was a depth of meaning in these words, so characteristic of the fatalistic Moslem, that I fully gaged only when I had more fully mastered the camel question in Australia. The country is crying out for "the ship of the desert," vast regions must remain untrodden by the foot of man without its aid, and the doing to death of a single Afghan most assuredly, in Abdul's terse words, "won't stop the camels."

The aversion shown by the horse to the camel seems in many cases to be quite unconquerable. A rider may coax his horse up to close quarters with a string of camels, but at any minute the steed is liable to turn and bolt at full gallop, trembling and perspiring profusely. A few horses are different in their behavior, but timidity in the presence of camels is the rule. Upon one occasion I was driving behind a horse and a splendid mule. The latter remained quiet, but the former, for fully a quarter of an hour before we sighted a caravan of camels, betrayed nervousness and kept his ears rigidly forward. He had *smelt* the camels long before we saw them. When we drove up carefully, he was evidently reassured by the stolidity of the mule at the other side of the carriage-pole, who seemed quite unconcerned at the presence of "the long nodding necks and gaunt swaying bodies of the huge hump-backed creatures going curtseying by," as the senior Kipling picturesquely describes a camel train. I asked a government stock inspector who had had great experience among camels whether the horse could be trained to become accustomed to camels.

"Very rarely, I think," was the reply, "if he once shows his fear of them. Some horses are all right. But each animal has its own work in Australia, and in this vast country need hardly ever see each other, so that the one need not interfere with the other."

The wonderful capacity of the camels to go for long periods without water is a qualification which constitutes their main usefulness in the arid regions of Australia. When the foliage of the shrubs upon which it feeds is green and succulent, the camel appears never to drink. The herd may be driven to water, but only the females with suckling calves drink. When its provender gets parched and dry, of course the animal partakes of water, but it

seldom drinks more than twice a week, though the fluid may be constantly accessible. In ordinary caravan work a spell of seven days without water, and also almost without food, is not a cause for wonder. The driver before starting sees that the hump from which the animal draws its reserves of food is in good condition. After two days or so out the camel is readily made to drink its fill, and in doing so stores away in the honey-combed lining of its stomach water enough for many days. There are many statements on record in regard to the feats performed by camels, but few tests have been more thorough, and none have been more fully substantiated, than those afforded by the Elder exploring expedition of 1891–92, that penetrated many hundreds of miles into the so-called great Australian desert. I have in my possession an autograph statement made by Mr. David Lindsay, leader of that expedition, from which some excerpts may be given :

Previous to the 20th August, 1891, my riding camel had carried me for 20 days on 6 gallons of water. On the 1st August all the camels except my riding camel had a drink. On the 24th August they had their next drink. On the 30th they all had a full drink, and we left for the march across the great Victoria desert, having 42 camels, some of them carrying as much as 700 pounds weight. On the 1st September at 25 miles the camels had 2½ gallons of water out of canvas troughs. On the 4th a few camels had 2½ gallons each. On the 7th the remainder of the camels had about 2½ gallons each of dirty water. On the 25th, an interval of 18 days, at 400 miles, in the evening the camels had about 2½ gallons,—some only 2 gallons. The whole of that journey had been over sandy country, much of it very hilly and all clothed with spinifex, the feed being of the poorest and not sufficient for the large caravan. The weather now became very hot, and we made 137 miles farther, reaching an out-station on the 3d October. I allowed the camels only 6 gallons each ; then we traveled seven miles out to feed. I was afraid, if I allowed the camels free access to the water after such a length of time without, that it would have killed some of them. Next day traveled 17 miles and gave them 6 gallons each. Next day they were allowed to drink their fill. It is worthy of note that none of the loading was left behind, and that only one camel was done, he reaching the water one hour after the caravan. From the appearance of the camels I judged that in three or four days farther without water four or five of them would have knocked up, but am sure that the remaining 35 or 36 would have gone from 7 to 12 days longer. My riding camels did 620 miles in the 34 days, the caravan doing 537 miles, as the crow flies, which of course was really a greal deal more owing to the bushes and hills causing the direction to be somewhat winding.

It will be seen, therefore, that the animals had spells of twenty-three days and twenty-one days (some only eighteen days upon the latter occasion) absolutely without water ; that all the time they carried heavy loads and traversed long distances ; and that in the great majority of cases the limit of endurance had not been

reached. This is what has been accomplished at a pinch during an exploring expedition, but of course in the ordinary transport-work of supplying stations or opening up gold-fields in Australia nothing approaching such endurance would be demanded from the animals, a week or at most ten days without access to water being the utmost privation they would be called upon to face.

The Pathan camel-driver in Australia is a stranger in a far land, friendless, misunderstood, misrepresented, hated, but withal cheerful and contented. He accepts his lot with all the fortitude of a Moslem, and he carries with him certain customs that remind him of his own country. After a long spell at caravan work in the interior, his one delight is to get down to the city of Adelaide, where his countrymen have built a mosque of somewhat imposing dimensions. Within the sacred precincts of this building such festivals as the Mohurrum or the Ramazan are observed with the same attention to detail as if the worshippers of the Prophet were in Bombay, Teheran, or Stamboul. During other times the exiles have another method of reminding themselves of home life. When any extensive caravan starts overland, among the number of the Pathan camel-drivers will be found a skilled musician, specially imported on account of his proficiency in manipulating the tom-tom and the Afghan equivalents of our fiddle and banjo. *Apropos* of this Pathan instrumentalist, I am reminded of an incident that happened to myself in one of the presidency cities of India. I had been present at a native festival, at which the night had been murdered by the screeching of pipes and the dull roll of tom-toms innumerable. As I was taking my departure, a native gentleman, who associated much with the English and was indeed a University graduate, remarked in all seriousness: "Well, there is at least one thing in which we natives of India excel the British. You cannot make music." And so, out in the Australian bush, I fancy not even a picked orchestra from Melbourne or Sydney could "make music" to please these Pathan camel-drivers.

THE FIELD OF DOMESTIC ENGINEERING.

By Leicester Allen, A. B., M. E.

UP to a very recent date the fact that an engineer of ability could find in the field of domestic appliances alone enough work to employ profitably all his energies, the exercise of a high degree of skill in it opening the door not only to competence but to fame, has been but dimly perceived. But those who first had the sagacity to devote themselves to the special engineering arts pertaining to the supply of light, heat, air, and water to buildings inhabited as dwellings or offices, or in which people assemble for business, amusement, or worship, are already enjoying, in most cases, a substantial reward.

To deal with an example, electricity had grown into a most important branch of domestic engineering in many other ways than mere illumination, although this is, and will long remain, the most important application of electricity to the comfort and luxury of mankind. Electric heating had not then reached, nor is it likely at present soon to reach, a stage of development that will render its importance comparable to the numerous and daily increasing minor uses of electricity in domestic economy. And unless the extended applications of engineering in modern office buildings, hotels, asylums, schools, hospitals, etc., are not considered as properly to be classed as "domestic," the interests of the trades named cover only a very small part of the total area in which engineering skill finds room for exercise in modern buildings. Hotels, asylums, schools, hospitals, and even prisons, are the permanent residences of some, and the temporary homes of a large number of their occupants; and in such buildings the application of engineering to the home life will be found to overlap into the territory of mechanical engineering, steam engineering, and hydraulic engineering, in the kitchen, the laundry, and the passenger-elevator; and even into the limits of pneumatic engineering in the steadily increasing applications of gas engines to the performance of various kinds of work in the culinary and laundering departments, and in the ventilation of buildings.

The scope of the term "domestic engineering," as applied to a distinct division of professional effort, is thus seen to be wide

enough to tax all the ability that can be brought into it; yet there is reason to expect that this scope will be enlarged in the future, so as to include yet undreamed-of possibilities. The spirit of progress will never cease to demand more of the aid of natural forces in the performance of the world's work; and the supply is apparently unlimited. Human ingenuity directed by science will work greater miracles than have yet been wrought; and in these benefits all classes will ultimately share in greater measure than is now apparent to those who look upon the mere surface of human events.

The tendency of the times is to the creation of a distinct department of engineering practice that will go hand in hand with that of the architect; the two professions working in harmony with each other in the perfection of architectural construction, which no longer includes mere beauty of design, but demands the maximum of convenience, comfort, and utility, with the minimum of cost in maintenance and labor applied to cleaning and other operations needful to health, comfort, and refinement of living. To this department the name chosen for the title of the present article is entirely appropriate, though some other equally suitable may be chosen.

The architect in future will seek more and more the aid of specialists in the different branches of engineering named, because adequate consideration of all these details will be beyond the power of any single mind, if undertaken in addition to the already sufficiently onerous labors of architects in the active practice of their profession. And art will be the gainer when, in the design of buildings, that which is necessary on the score of utility is first well thought out and provided for, leaving the artistic incorporation of these things into the general design entirely unembarrassed by any contingency which may compel alterations. In a case wherein all the engineering appliances that are to be used are decided upon in advance, and their positions and the space that will be occupied by them has been determined, the architect is, at the outset, placed face to face with such definite limitations as will to a great extent influence his work; and he can scarcely fail to design more intelligently and artistically than if these limitations are dimly perceived, or perhaps left out of sight altogether.

The engineering specialist who would occupy this opening field of usefulness will need peculiar qualifications. It will not be enough that he is well instructed in the general principles of en-

gineering, that he is experienced in the construction of the great variety of machinery now concerned in the domestic economy of such buildings as have been named, and could, if called upon, design any one of them and superintend its erection in a machine-shop. In addition to such knowledge, he must be able to plan for its arrangement in a proposed building in such manner as not to absorb valuable space that could be better occupied, and in such manner that all will be convenient and develop the highest utility possible under the circumstances. He will have to learn that all the limitations do not fall to the lot of the architect, and that he must cheerfully take his share of them. He will have to be familiar with the uses of every machine that must be provided for,—not merely in a general way, but also in an operative sense,—in order that he may not overlook the numberless practical points that are of great importance in the aggregate. A considerable, but brief, inconvenience, experienced only at rare intervals, will be much more patiently submitted to than much smaller inconveniences of daily or hourly occurrence. In arranging a laundry, for instance, he will have much the same kind of problem to solve as he would face in the planning of a machine-shop, or a factory for the production of a particular kind of goods. He will often be obliged to abandon precedent and rely upon his own unaided judgment in locating all the machinery, because he will find very few buildings exactly alike either in purpose or in their shape or dimensions. He, therefore, no less than the architect, will be compelled to adapt his work to new conditions. In arranging for cooking-appliances in the kitchen he will meet with the same limitations. A certain space of a certain shape can be afforded, and in this he will be obliged to place all the numerous paraphernalia of the cuisine, some of them involving the use of steam for boiling, others perhaps involving the use of gas as fuel ; and in addition to these the range, which is indispensable in the preparation of food on a large scale. Then there will be the water-supply for kitchen and scullery to be considered, and the arrangement of all these appliances in such a judicious order that the use of one thing does not interfere with the free use of any other. Obviously the domestic engineer of the future will have to add to the general qualifications now possessed a knowledge of the order and routine of domestic work, in order to acquire perfected judgment in providing for all its requirements.

But there is a narrower sense in which the term "domestic

engineering" is still appropriate. The houses of the well-to-do are yearly requiring more complicated and elaborate outfits. Not only are such houses mostly warmed and ventilated by steam and hot-water apparatus, but they are lighted by electricity if favorably located, or by gas manufactured on the premises if remote from city gas-supplies. In not a few instances electric light is supplied by a special plant requiring a special attendant for its care, and such installations require the same grade of skill in their design and erection, as well as for their attendance while running, as is needed for larger plants, furnishing light from central stations in cities. This is the case with many seaside-resorts, hotels, asylums, and sanitariums, which retain in their employ engineers competent to take charge of the running and repair of all their machinery. These engineers in turn employ subordinates. The number of engineers so employed in every large city is daily becoming larger. Engineers of this class are much superior on the average to those who were once employed to take charge of steam-engines for manufacturing purposes. They are forced, in order to obtain and hold their positions, to know much more than was thought necessary for an engineer to know in former years to render him competent to take charge of a steam-engine. The steam-engine does not claim all the attention of men engaged in this occupation. They must bring to their task a practical knowledge and familiarity with pumping-machinery, with heating apparatus, with the machinery of passenger-elevators, with dynamos, and with electric lamps and wiring. I have often been impressed in conversation with such men by the extent of their attainments, and surprised by their theoretical knowledge. Many of them are competent to detect subtle errors in principles inadvertently made by those who have had far greater educational advantages. These, then, may properly be called "domestic engineers." As time goes on they will find it necessary to keep up with the procession, and they realize this fact. They are usually careful readers of engineering periodicals, and some of them are quite as competent to contribute to engineering literature, upon practical subjects, as many of those who have some reputation as technical writers.

Still another class of men are entitled to range themselves in the ranks of domestic engineers. Their work, though not of a conspicuous kind, is not on that account less meritorious, or of less moment as regards the public welfare. The large part of mankind live in comparatively humble dwellings, and in these are

to be found the work of the domestic engineers now to be considered. These homes are usually the abodes of such as find it necessary to practise economy in all expenditures, and who, because they cannot afford to gratify all their wishes, must make the best of what they can get.

Expensive heating-plants and electric lighting are beyond their reach. There must be something cheaper, but it must not on that account be intrinsically bad. They will waive luxury, but insist upon comfort; and though they are willing to forego style in their household arrangements, they want what they have to be in accordance with sanitary requirements. For these have been invented, in the heating and plumbing trades, a series of devices as much entitled to be embraced in domestic engineering as the costly outfits of more ambitious dwellings. The amount of intelligence and careful study that has been brought to bear upon the subject of furnace-heating, and upon the construction of stoves and ranges that can be afforded at a moderate price, is known to few outside of the trade. And the success attained by these means of heating is such that it cannot be ignored by any one who looks at the subject of heating and ventilation with an impartial mind. While any such man will not admit that furnace-heating is to be preferred to hot water or steam, he will be compelled to admit that it is the best system of heating ever placed within the reach of people of moderate means. And if he pursues the subject into the intricacies of construction of these useful devices, he will be compelled to admit, also, that the same kind of careful thought and attention to fundamental principles has been necessary to bring the art to its present advanced state as has been essential to success in any other branch of industry.

The problems of good furnace-heating are not all general so that once solved for any particular case they are forever solved for any other possible case. As much depends upon careful adaptation of a hot-air furnace to the particular building in which it is to be used as is involved in the erection of apparatus for any other kind of heating. Things cannot be safely guessed at in any system of heating; and the most successful in the erection of warm-air furnaces, as well as in the erection of steam and hot-water apparatus, are those who do the least guessing. The rule of thumb finds no more appropriate place in heating and ventilation than it does in working out a strain-sheet for a bridge, or in running a line for a railway. In the art of ventilation, especially,

the failures are to be mostly attributed to a departure from methods of calculation and construction that hold good in all engineering work. The omission to observe and strictly follow these methods, even in seemingly minor details, though it does not always result in failure, introduces the possibility of it, and nearly always results in a measure of inefficiency that could have been avoided by right calculation. Therefore the erection of such apparatus is engineering work whenever, even in the smallest installment, it is done in accordance with sound engineering principles.

The art of landscape gardening, so far as it relates to the improvement, beautifying, and irrigation of grounds belonging to any building in which people are housed, ranges itself under the inclusive title of "domestic engineering." This art, as a distinct profession, is of comparatively recent date in the United States, one of the earliest examples of it being Central Park, in New York city. But the systematic grading and adornment of gardens and grounds was practised long before Central Park was projected. The demand for such work, however, in its highest perfection was too limited in the earlier history of the country to encourage the practice of this art as a specialty. Now that the country has accumulated wealth, and the art sense of its people has been cultivated by travel, the demand not only for the highest type of architecture in buildings, but for appropriate artistic environment for such buildings, has opened an attractive field for the practice of landscape engineering.

Some have dreamed of a period of material and social progress when mankind shall be emancipated in large measure from toil; when a more equal distribution of wealth will prevail; and when a life of comparative luxury and ease will be within the reach of all those who now labor hopelessly to attain it; a period when "Man to man, the world o'er, shall brothers be and a' that." So dreamed that manly poet, Robert Burns; so have dreamed many others who have pictured the families of men dwelling together in fraternal association in large, cleanly, handsome buildings filled with and surrounded by all that makes life worth living. This dream of the future of the human race, whether chimerical or not, is always a peculiarly attractive one. Should such a period ever arrive, domestic engineering will rise to the first rank in the ameliorating influences which mitigate trials mankind can never wholly escape.

ELECTRICITY

Conducted by Franklin L. Pope.

THE most important event which has recently occurred in electrical circles was the International Congress of Electricians, which convened in Chicago on August 21, and was attended by several hundred delegates and leading electricians from all parts of the world. The veteran physicist von Helmholtz, of Germany, was elected honorary president, and Dr. Elisha Gray, of Chicago, chairman. The papers presented in the working sections of the Congress were for the most part admirable in their scope and treatment, and may be said to have fairly well covered the entire field of industrial electro-technics. The marked preponderance, both in number and importance, of the papers having reference to problems connected with the utilization of the alternating current is one of the most significant features of the occasion, and serves to bring out in strong relief the fact, which has for some time been patent to all thoughtful observers of the tendencies of the time, that the alternating system, in spite of the bitter and unscrupulous opposition which it was compelled to encounter during the first years of its employment in this country, is surely destined to be the system of the future. In fact, appearances indicate that the direct-current system of distribution, so far as central station work is concerned, has already been definitely abandoned, at least in the United States.

IN the course of the proceedings, a most instructive and interesting discussion took place in reference to the employment of alternating and polyphase motors for the transmission of power. Each of the three systems now in practical use—the direct-current, the alternating single-phase, and the alternating polyphase—found ardent advocates, but the discussion showed that the champions of the direct current were decidedly in the minority. The general consensus of opinion, especially among the European engineers, appeared to be that the simple single-phase alternating system is likely to become the system of the future, although the polyphase system found its strongest supporters among American engineers of extended practical experience. A prominent electrical engineer who holds an important position in connection with the Niagara Falls enterprise stated that bids for the apparatus to be used there were received from all the principal firms in the world, and that the estimates of cost for continuous current apparatus were in every instance largely in excess of those for alternating apparatus. The distribution at Niagara will be either by means of overhead conductors, or by bare wires carried in a subway. The latter system, however, will be very expensive, except for short distances. It is probable that overhead wires will have to be used, and that people will have to learn, by experience or otherwise, to keep away from them and let them alone.

THE illumination of the central nave in the Manufactures building at the World's Columbian Exposition is the most unique and magnificent example of electric-arc lighting in the world. Five great coronas, carrying 414 two thousand candle-power arc-lights, are suspended at a height of 140 feet from the floor. The space lighted is 1300 feet long, 368 feet wide, and 202 feet high.

THE retirement of Mr. Henry M. Whitney from the presidency of the West End Street Railway Company, of Boston, leads us to remark that to him, far more than to any one man, is due the wonderful revolu-

tion that has taken place during the past six years in the methods of street railway transportation by the application of electrical power. Starting with the nucleus of a comparatively unimportant line projected in the interest of a real estate enterprise, by his masterly policy he effected the consolidation therewith of all the conflicting street-railway interests of Boston, and, having the sagacity to see that the electric motor, though yet in a crude and undeveloped state, was destined to be the motive power of the future, he possessed the rare courage of his convictions which led him to test its merits on a scale hitherto unprecedented, and thus solved, by a single stroke, and for all time, the question of the commercial practicability of the electric street-railway for large cities. When the history of the commercial and social development of the nineteenth century comes to be written, the mark which has been made upon its records by Mr. Whitney will be found to have been both broad and deep. The vast industries which have grown up, as if by magic, in response to the urgent demand for electric transit in every city, town, and village of the United States, may be said almost to owe their very existence to his bold, energetic, and far-sighted policy, which created a market for their products that, in the ordinary course of events, could not have been developed for many years to come.

IF it is possible, as we know from actual experience that it is, to construct a machine like a bicycle, which weighs only thirty or forty pounds, and will carry a person of four or five times its own weight over a road only moderately smooth, at a speed of fifteen or twenty miles per hour, with only an inconsiderable amount of wear and tear, why is it not equally possible to construct an electric motor-car, which runs on a smooth and well-surfaced track, in which the proportion of dead weight per passenger should be but little if any greater than it is in the bicycle? Evidently it is possible, and therefore it is worth while for some of our mechanical engineers to concentrate their attention upon the problem. The condition of the 90-pound steel rails, laid less than two years ago by the West End Company of Boston, gives conclusive evidence that the ordinary motor-car of to-day is far more destructive to the integrity of the track than are the 75-ton locomotives even at the high speeds of the steam trunk-lines.

A RECENT publication of the electrical statistics of Switzerland for the year 1891-92, states that there are in that country 1600 alternating and 1165 direct current lighting installations, nineteen power-transmission plants using 77 machines and having a total capacity of 2380 kilowatts; four electric street-railways, and three electrical mountain cable railways. In one of the power-transmission plants, 450 horse-power is transmitted 11½ miles at a pressure of 13,000 volts. The electrical engineering of Switzerland has for years been deservedly famous for its boldness, originality, and success. It is not unlikely that, thanks to its waterfalls and the skill of its electricians, this little mountain republic may in time become one of the principal manufacturing countries of Europe.

RETURNS for one year from the fire departments of sixty different cities in the United States, selected from among those having more than 20,000 inhabitants, show that the fires attributed to electricity constitute 1.19 per cent. of the aggregate number, and 1.23 per cent. of the aggregate losses. New York city heads the list with 59 fires, followed by Boston with 26. The generator capacity of the electric light and power plants now running in these cities, including central stations, isolated plants, and street railways, amounts to more than 200,000,000 watts, which is equivalent to nearly 4,000,000 16-candle power incandescent lamps, or 285,000 horse-power.

A MODEL electrical kitchen has been fitted up in Boston by a concern engaged in the manufacture of electrical heating appliances, which presents many features of interest to the householder. In the left-hand corner is a vertical boiler, which supplies hot water to a sink in the right-hand corner. Next to the heater is an oven, in

which a number of different dishes may be cooked simultaneously in the two lower compartments, while the upper compartment forms a hot-closet. On top of the oven is a broiler, which in a few minutes will cook a steak or chop to perfection. In the center is the range, consisting of a chest of drawers with a slate top, having a capacity for half-a-dozen different cooking utensils, and above this is a switchboard, with plugs and flexible cords, by which electrical attachment is made to such utensils as are required to be heated.

IN a recent lecture before the Franklin Institute, Nikola Tesla stated that so strong had become his conviction of the possibility of the transmission of intelligible signals and perhaps even of mechanical energy to any distance without the use of conducting wires, that he no longer regarded it in the light of a mere theoretical possibility, but as a serious problem in electrical engineering which seemed to him certain to be carried out. He looks upon this result as nothing more than the natural outcome of the most recent investigations by himself and by others who have been engaged in the study of the phenomena of high-frequency alternating currents.

THE incandescent light plant at the World's Fair is said to be capable of keeping 180,000 16-candle-power lamps alight at once, if required, which would be equivalent to the consumption of over 1,000,000 cubic feet of gas per hour. This is believed to be by far the largest single plant yet constructed.

NOT many weeks ago telegraphic intercommunication between several of the principal business centers of the United States was nearly interrupted, and in some cases entirely so, by a heavy wind-storm, which prostrated the poles and wires in all directions to such an extent that a fortnight or three weeks scarcely sufficed to repair damages. This thing happens periodically at intervals of two or three years, and the public is beginning to inquire, with considerable interest, whether anything is going to be done about it. A well-known wise and witty engineer once summed up a discussion which had been going on for some months in the technical journals as to the cause of the breakage of railway rails, by observing that the obvious reason was that they were not made as strong as they ought to be. The fact that among the general wreckage of overhead wires those of the long distance telephone usually suffer but little in comparison with those of the telegraph companies is suggestive of a similar explanation. The real difference between the two is that the telephone lines are constructed by trained engineers and the strains are scientifically adjusted to meet the conditions likely to be met with, while those of the telegraph companies are planned by men often but little if any above the grade of ordinary day-laborers, and so, when an unusual storm occurs, they go down. Who ever saw a Western Union telegraph-pole, on a railway or in a country district, on which the cross-arms were accurately parallel to each other, and exactly at right-angles to the pole? Who ever saw one provided with iron braces to maintain the parallelism? But something more is needed than even good engineering before we shall have a satisfactory telegraph service which can be absolutely relied on at all times, and that is a radical change in the system of construction of the principal trunk-lines. Underground cables, of say five conductors, should be laid between all the principal commercial cities of the United States. The expense of these would not be excessive, and then we should always be sure of being able to use some wires, even under the most unfavorable conditions. The commercial public ought to insist upon this reform being carried out. It is conceivable that circumstances might occur which would render a complete interruption of telegraphic communication between our principal cities as disastrous a thing as could possibly happen.

PROFESSOR EWING thinks that chemical analysis is a very imperfect means of estimating the magnetic qualities of the iron used in the cores of dynamos and trans-

formers. Manganese, which is so essential to the strength and toughness of ingot iron, is most deleterious to its magnetic qualities. While much attention has been paid by electrical engineers to the design and proportions of transformers, but little appears as yet to be accurately known in respect to the material which mainly determines their efficiency.

THE returns of the American Bell Telephone Company for August show a net decrease of 2435 in the number of instruments in use. This is one of the results of the financial stringency.

THE hackmen of Toronto are delighted that the citizens of that municipality have voted, by a considerable majority, not to permit the street-cars to be run on Sunday.

THE utilization of water-power by electrical transmission bids fair to make Switzerland, at no distant day, one of the leading manufacturing districts of the world. Her electrical engineers were the first to demonstrate the practicability of electric power-transmission in large units under commercial conditions, and the abundant opportunities for utilizing excellent water-powers at a comparatively moderate outlay for hydraulic works have greatly stimulated the progress of the electrical industries in that republic. At the end of 1892, according to Professor Desler, of the Zurich Polytechnic School, there were in operation 552 electric-light installations; 52 plants for the electrical transmission of power; 121 storage-battery installations; and 1056 dynamos and electric motors. The number of arc lamps is 9746, and of incandescent lamps (presumably reckoned on an 8-candle-power basis) 115,926.

WE agree with the *Electrical Engineer* that there is altogether too much noise made by the electric street-car gong. Used so continually as it is on most of the existing lines, it loses all its efficacy as a danger signal, to say nothing of the intolerable nuisance of having a new and vehement variety of racket superadded to that already existing in the streets of our American towns, which had already earned the unenviable distinction of being the noisiest in the known world. Why not use a continuous, but not very loud "jingle-bell," like that of a horse-car, and reserve the gong for occasions of actual and imminent danger? There are times when the gong is necessary, but they are comparatively few.

THE Ohio State University has conferred the degree of Electrical Engineer upon a young woman, who is said to have stood at the head of her class all the way through, and who upon her graduation was offered and has accepted a responsible position with one of the leading electrical manufacturing companies. There is really no reason why many of the branches of electrrical engineering might not be carried on as well by women as by men, and indeed there are many processes requiring so high a degree of skill, dexterity, and unwearied patience that the characteristic mental and physical endowments of woman would seem likely to give her a decided advantage.

WHEN a bolt of lightning strikes into a mass of sand, it sometimes fuses the silica in such a manner as to form a tube of glass. Such a formation is termed a fulgurite, and specimens are said to have been found as much as thirty feet in length. Fulgurites occur in great abundance upon the summit of Little Ararat in Armenia, which is composed of soft porous rock. Blocks a foot square have been obtained from this locality, perforated in all directions by little tubes lined with bottle-green glass formed from the fused rock. A fulgurite found in Maryland, and recently examined by the writer, was something over a foot in length, and about three-fourths of an inch in internal diameter. Specimens have been found which were three inches in diameter.

A VERY interesting experiment has been made by Mr. W. H. Preece on the transmission of electric signals through space without wires. A heavy copper conductor

was suspended on poles for a distance of 1267 yards along the shore of the Bristol channel. On an island 3.1 miles distant a gutta-percha-covered wire 600 yards in length was laid. Through the shore circuit an alternating current of 150 volts and a maximum strength of sixteen amperes was transmitted, which could be broken up into signals in the usual way by means of a Morse key. Telephones in the secondary line were used for receiving instruments. No difficulty was experienced in reading the signals at this distance, but, when tried with a wire laid on another island at a distance of 5.35 miles, though signals could be perceived, intelligible communication was found to be impossible. Mr. Preece finds it essential, to insure good results, that the secondary wire should be of a length at least equal to the distance between it and the primary wire. The system therefore fails to provide for the cases of isolated lighthouses and lightships, where such a means of communication, if practicable, might often prove of the greatest value. Experiments are now in progress to determine whether this principle is available for indicating the approach of a vessel to lighthouses and landfalls, but no results have as yet been made public.

A SUBMARINE cable has recently been laid between Scotland and Ireland by the British Post-office Department, by means of which direct telephonic communication has been established between Glasgow and Belfast. No facilities are given, however, by which exchange subscribers can be connected with the line, and hence it is necessary for two persons desiring to converse to make an appointment beforehand by telegraph, and then, at whatever inconvenience, to betake themselves to the central telegraph-offices in the respective towns at the particular hour agreed upon. This is a fair sample of the kind of accommodations that we would be likely to get if the telephone system in this country should be turned over to the government which many persons have been convinced by the newspapers it would be a good thing to do.

A LARGE underground telephone cable was removed a few weeks since from a conduit in Brooklyn, the lead covering of which had been completely destroyed by electrolysis due to the strong return currents of the electric-railway circuits. It is much to be feared that this is only the beginning of one of the the most serious difficulties which the electric-railway system will be called upon to encounter.

IT is said the introduction of the electric railway in Ottawa, Ontario, has brought about a reduction of several hundred in the number of horses kept within the city limits. This information comes from the officials of the water-works, who are probably in a better position to know than any one else, as it is customary to make a special charge for water for each horse kept by their consumers. The number of licensed hackmen in the city has fallen also, from 195 in 1890 to about 100 the present year. It costs nearly $200 per year to keep a horse; so it is evident that the electric railway is saving considerable money to the citizens of Ottawa. If things keep on in this way for another century, one will be compelled to visit a menagerie, or a zoological museum, if he wants to see an actual horse.

THE rigid enforcement of the Edison incandescent-lamp patent by the courts, and the disinclination of the management of the General Electric Company, its present owners, to enter into any arrangement to permit the lamp to be manufactured on a royalty basis by others, has had the effect of stimulating the inventive capacity of the electricians employed by rival interests, with the result that at least two new types of lamp have been put upon the market, which apparently bid fair to be commercially successful, while it is, to say the least, extremely doubtful whether the courts will pronounce either of them to be infringements of the patent. In one of the new lamps the neck of the globe is closed with a separate stopper, instead of being formed integrally, as in the Edison lamp, and in the other a fusible cement is made to serve the same purpose.

ARCHITECTURE

Conducted by Barr Ferree.

NO apology is needed for the unusual amount of space World's Fair matters have occupied in these pages during the last two months and the present. The World's Columbian Exposition is the most important topic now before the American people, barring, of course, the financial troubles, and it is thus eminently proper that it should be here considered in all its architectural aspects, meanings, and significations. But there is a stronger reason than this that necessitates the amount of space we have given to this subject, and that is that the architectural publications of this country have been notoriously derelict in publishing reports on such questions and phases of the Fair as especially pertains to their scope. Architectural journalism in the United States is not a thing of joy to the profession, and it has more than once proved itself deficient in things where it should have done better. But it must be confessed that in the matter of the World's Fair it has shown itself thoroughly unpatriotic both to the country and to the profession. Its duty to the latter certainly does not begin and end with the publication of photographs. One exception may, however, be mentioned: our lively western contemporary *The Inland Architect* has begun the publication of a series of articles on architecture at the Fair, and is thus doing a work no other publication of its class has undertaken. We feel, therefore, that we may be doing a not useless work if the architectural side of the Fair is reviewed here in all its relations, for it is a work that has not yet been undertaken in this country. The popular magazines have exceeded the professional journals in the amount of space given to the Fair, although not all of this is architectural, nor is all of it in line with common sense or truth. The most important effort to illustrate the Fair completely is unquestionably that of *The Cosmopolitan*, whose World's Fair number is a miracle of illustration, and is by far the most satisfactory popular treatment of the subject we have seen, so far as the pictures are concerned. These are extremely numerous and of great beauty; the text is not so successful, being more heterogeneous contributions from great names than a serious undertaking to treat the Fair as a whole. Several technical papers have treated of their specialty at the Fair. One of the most interesting series we have seen is that on iron in *The Iron Age* (New York). The best architectural account is the series of papers appearing in *The Builder* (London), very complete, very just, and very appreciative.

THOUGH it is most natural, in considering the structural architecture of the Fair, to devote one's attention to the main buildings, the minor buildings—those built by the different States, foreign countries, special exhibits, and the like—greatly exceed the larger ones in number and variety. These latter structures have not yet received the attention they should have, for, even if many of them are of no special architectural importance, they teach lessons, negative as well as positive, that should not be ignored. The most notable article on the State buildings that has appeared is that by Mr. Montgomery Schuyler in *The Architectural Record* for July-September. This was evidently written in the early days of the Fair, since it does not attempt to cover all the buildings, and the illustrations that accompany it are from drawings, not from photographs. But the article itself is extremely well written and is in Mr. Schuyler's best

style. It would be an easy matter, were we to try to cover the whole field, to begin the study of the State buildings by the process of elimination, dropping out the most insignificant, and continuing the operation until only the good remained. The chief drawback to this would be that there would be very little left. The New York State building stands preëminent by reason of its palatial luxury and general magnificence, quite in keeping with the wealth of the Empire State, but one cannot but regret that the leading State of the union is represented by a building that is so manifestly based on another building in a foreign country. Massachusetts can take greater satisfaction in its reproduction of a colonial mansion, which adequately represents it in character and in architectural strength. Pennsylvania has tried the effect of using the tower of its most sacred edifice—Independence Hall—as the chief motive of its design, and with fair success, though neither the tower of Independence Hall nor the hall itself is an architectural work to be admired for anything save its historic associations. But at least we may be thankful that the Philadelphia City Hall was not taken as a *motif*. California has unquestionably the most successful State building, the style—that of the early Californian missions—being at once typical and suggestive. It would be a most rash procedure to group the remaining buildings—an almost infinite number, if such an impossible comparison be permitted—into a single lot, and dub them "unnoticeable," but the fact is that many of them are very mediocre, and even when they undertake to be typical a great many only try to do something they cannot.

AT first glance it might appear to be the bounden duty of every foreign country and separate State to provide itself with a building thoroughly representative and characteristic. But this was manifestly impossible in the case of the American States, so many of them having practically similar characters and products. With foreign countries the case is somewhat different, because with them the opportunities for independent growth were much superior. Yet several of the foreign countries have erected buildings that might as well belong to any other country as the one they are especially supposed to represent. The Brazilian building is a good instance, a florid Renaissance structure that suggests Brazil only because the Brazilian flag floats over its roof. It is certainly not less French than the French building itself. This latter is an ingeniously arranged little structure, very interesting and admirably expressing its purpose. The German building is unquestionably the most characteristic of the structures built by European nations. And it is also abominably ugly. Still it adds to the festal variety of the show, and notwithstanding its aggressively German character is a welcome addition to the structures upon the Fair grounds. The Swedish building is another edifice that has little artistic beauty to excuse it. What its relationship to Swedish national architecture may be we do not know; but it certainly achieves its end if that is the making of a striking building. The most objectionable part of the design is the huge central feature that strides over the centre. India has a rather charming little bazaar, not very large, and rather tinsellish in effect, but thoroughly characteristic and thus, on the whole, satisfactory. The most pretentious of the foreign buildings is that erected by Great Britain, and known as "Victoria House." It is pretentious, not on account of its size, which is less, we believe, than that of the German building, but because it has been built of brick, stone, and wood, and is intended to be permanent. In this particular it enjoys a great advantage over the other buildings, though brick enters into the construction of the Swedish building. It is a very well meant effort to reproduce an English country-house, and, while no one could, for a moment, mistake it for what it is intended to be, it is a very close approach to its prototype. Apart from this fault—of setting out to accomplish something practically impossible of accomplishment—the building is a careful piece of work and well merits study. Its situation, with the surface of Lake Michigan as a background,

is especially happy, and adds much to the effectiveness of the architecture. Many lesser foreign countries have individual buildings, few of which call for special mention. Economy in such structures is not to be deplored, since building a house in Jackson Park was an expensive operation, and the smallest, roughest structure is so thoroughly sufficient as an expression of good will as to render it unkind and unnecessary to find fault because there are not a dozen Victoria houses instead of one. The function of the foreign buildings is not very clear, and in most instances they have helped to add to the confusion of the classification by being used to house exhibits. This makes the building, no doubt, more useful than if used as headquarters only, but it materially detracts from a symmetrical Exposition arrangement.

UNDER the general head of building materials and appliances a variety of exhibits are distributed throughout the Manufactures and Liberal Arts building. Doubtless all of these are arranged on a legitimate basis of classification, but the architectural student is put to a good deal of hard work in looking for the objects touching upon his profession if he would see them all. The foreign exhibits are apparently more insignificant in this department than in any other; certainly it would be difficult for them to be less in quantity and quality. With the exception of a few displays in Belgium no foreign country makes any pretense of building displays. The most notable feature of the Belgium display is that of the Vielle Montagne Zinc Co., located near Liége, Belgium. The company makes a very complete display of their zinc roofing plates, showing models of construction, etc. Roofing materials are also well shown in the American section, chiefly metallic roofing, though a few firms show roofing tiles. These exhibits are generally arranged in the form of model houses, showing the products in practical application,—a most useful idea, though the architecture of the booths is, as a rule, very bad indeed. It seems scarcely necessary to refer to the individual characteristics of these displays, since most of the goods shown have been upon the American market for a number of years past, and their qualities are thus well known to American architects. On the whole this section of the exhibition, though not numerously filled, may be termed tolerably complete. Some few exhibits of bricks and artificial building materials are shown in the same building. A very fine exhibit is made by the Hydraulic Pressed Brick Company, who have built a series of alcoves or pavilions, showing their products in all grades and colors. This is one of the most tasteful displays in the exhibition. Several other brick-making firms have similar displays. All of them, of course, are in the form of erected constructions. Closely allied to these is the exhibit of the Pioneer Fireproof Construction Company, of Chicago, who have prepared a good display of their fireproofing materials, shown in practical application. No attendant was on hand when we saw this exhibit, and no information could then be had concerning it. This was not an unusual circumstance, since during the early months of the exhibition there was an amazing dearth of attendants. It seems astonishing that firms would spend thousands of dollars in preparing a display and then leave it alone unattended as though it was a thing to be ashamed of.

STILL confining ourselves to the Manutures and Liberal Arts building, the sanitary display is next in order. A very good line of water-closets is shown, some sinks, some bath-tubs,and some plumbing fittings. The most marked feature of this collection—and indeed the same thing characterizes all the sections touching upon architecture—is the absence of novelties. It is doubtless a source of considerable satisfaction to the manufacturer to be able to make an effective display of his products at a great international exhibition from his ordinary stock alone, without the extra expense of new and costly objects, but, when with this is shown the lack of new things, the beauty of the arrangement is not so obvious. It is quite true that business methods in America are such that the

most startling thing becomes old in an incredibly short time, and our manufacturers lose no time in putting the newest things upon the market. But it does seem not unreasonable to look for a fair proportion of new ideas among the vast collections at Chicago; and yet, as a matter of fact, very few things are shown that the public is not already familiar with. This is what the manufacturer is content to rest his claim upon for an award of merit, and that is what takes him to Chicago and has induced him to spend his money in making a display there. It follows, therefore, that few novelties are to be found in the section of sanitation, so large a firm as that of Peck Brothers, of New York, contenting themselves with a line of stock goods. This in itself is very good and fine, and is the largest collection of the kind in the exhibition, but it contains nothing that has not been previously before the public. We are obliged to confess that, until we saw them at the World's Fair, we did not know that such a thing as a folding bath-tub, covered with plush and presenting the outward semblance, when closed, of an eminently respectable lounge, was upon the market. But the manufacturer of this product comforted us with the assurance that that was no disgrace, since his goods were not much used in large cities, being designed for country houses or for small towns. A portable bath-tub is unquestionably a great convenience and a most useful article of household furniture, but, when it is covered with blue plush and turned into a sofa when not put to its legitimate (?) use, it seems to us to lose very much of its value as a bath-tub and as a sofa. We do not wish to be unnecessarily harsh upon the gentleman who devised this most useful arrangement, but we confess we should like to hear some reports from those who are accustomed to bathe daily in a plush-covered tub, and especially some information as to the condition of the aforementioned plush after it had served as an adjunct for, let us say, a year's baths.

A DOZEN or so of the better-known firms supplying the American market make exhibits of bath-tubs, stationary wash-stands, and the like. Porcelain tubs are shown in considerable variety, though, after all, there seems to be small difference between the work of different manufacturers. The largest display is that made by the Standard Manufacturing Company, of Pittsburgh. They show, among other special features, a model bath-room, the walls and floor of which are covered with imported tiles, and which is supplied with all the requisites of luxurious bathing. The cost of this room, which is much larger than the average bath-room in the average city house, and which is supplied with simply the best grade of stock goods, is stated to have been $4000, and in these hard times this may be instructively compared with the shower-bath shown by the Peck Brothers that may be purchased for a little less than $600. The Standard Manufacturing Company also show what is said to be the largest bath-tub ever made. It is a replica of a dozen made for the Mormon temple at Salt Lake City, and is ten or twelve feet long and proportionately deep. Unfortunately no information as to the nature of the religious ceremony in which these twelve monster bath-tubs figure is given. The display of water-closets is perhaps more varied than that of the bath-tubs, though the number of exhibitors is not very great. Still the largest firms are represented, and several of the displays are well worth visiting. It would require much more space than can here be given to it to examine these exhibits critically, and hence we can only briefly comment on the more striking features. Of these one of the most ingenious is the sectional model of the water-closet made by the Sanitas Manufacturing Company, of Boston, which, by means of a glass plate, enables one to actually follow the system of flushing in practical use. More interesting, and, we understand, a genuine novelty, is the noiseless water-closet made by Norton Brothers of Chicago, and called the Norton Hermetic Seal Noiseless Sanitary Fixture. This is quite a long name, but it well describes a water-closet that flushes the basin in an absolutely noiseless manner. This is a feature that every householder will welcome most heartily, since

the noise made by the modern flushing water-closet is one of its most serious drawbacks. A further collection of sanitary appliances and devices are shown in the Anthropological building,—so delightfully are architectural objects and subjects distributed throughout the grounds,—but a consideration of its chief points must be postponed to another time.

ANOTHER small collection allied to architecture may be found in the north gallery of the Manufactures and Liberal Arts building. From the exhibitor's standpoint the galleries have not been a success, nor is it much wonder, since they can only be reached by climbing high flights of steps, no elevators, by a gigantic oversight, having been provided for them. There is a dreary loneliness about these great galleries that would be extremely restful after mingling with the crowds below, were there greater seat accommodation whereon one might rest an exhausted body, for without an exhausted body it is quite impossible to see a thing at the World's Columbian Exposition. What we have termed the architectural section—which we believe it is called in the official catalogue—is no exception to the general loneliness. It includes a mixed variety of exhibits, such as paints, lathing, window apparatus, and similar articles, not very complete as a display, or very well arranged, but the best of its kind in the Exposition. This seems to be rather the miscellaneous department, where objects that could not be delegated to other sections have been placed. It is not, as has been said, an invigorating display. Nor, for that matter, is any part of the architectural subjects. When one thinks of what might have been done and what has been done, it is hard to resist wholesale condemnation of what may be seen. It is, of course, now too late to accomplish anything by bewailing the hard hand of fate, but, as we pointed out in the Magazine last month, the architect who goes to Chicago to learn professionally will find little but the buildings themselves and their *ensemble* to give him profit.

SEVERAL books and pamphlets are on our table awaiting acknowledgment and review. They may be hastily noted here reserving more extended notice, should opportunity offer, for another occasion. ——Messrs. Jones & Laughlins, Limited have issued a valuable little hand-book, entitled "Standard Steel Construction,"* a manual of beams, channels, and structural shapes, arranged by J. M. Larimer. Although put out as a catalogue of the firm's own products, the book contains a number of tables, compactly arranged, and is admirably adapted to the convenience of architectural engineers and architects.—— Mr. George Hill, whose name is familiar to the readers of the Magazine, has reprinted, for private distribution, his admirable paper on "Modern Office Buildings,"† originally printed in the *Architectural Record*. We had occasion to notice this article—quite the most useful thing of its kind we have seen—when it first appeared, and need add nothing to what we said then save to commend it afresh to our readers. We must protest, however, against Mr. Hill's sub-title, "Practical Limiting Conditions in their Design." He has very little to say about design as it is generally understood. What he is most concerned with is planning,—vertical planning and horizontal planning; about the design of the façade he has nothing whatever to say. Had he used the word "Plan" in place of "Design" in his sub-title, he would have expressed his purpose precisely.——The catalogues issued by the Winslow Brothers Company‡ of Chicago for the current year merit more than casual attention. Their Photogravure Edition is a sumptuous book, bound in cloth, and containing one hundred and forty-one photogravure plates of work executed by them. The plates are finely printed, and the volume is an important index to noteworthy recent work. Taken as a whole, the work of this company attains a high

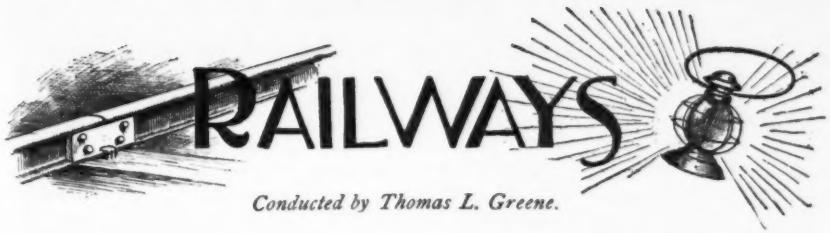
**Standard Steel Construction.* Arranged by J. M. Larimer. Pittsburgh, 1893. Jones and Laughlins, Limited.

†*Modern Office Buildings: Practical Limiting Conditions in their Design.* By George Hill, C. E. New York [1893.] [Privately Printed.]

‡*Collection of Photographs of "Ornamental Iron."* Chicago, 1893 Winslow Bros. Co.

order of excellence, and their catalogues amply testify to the good work they are doing for ornamental iron in this country. ——The catalogue of the Berlin Iron Bridge Co. (East Berlin) also merits acknowledgment in this place. While chiefly concerned with the building of shops and warehouses, this catalogue may be profitably studied by every builder and engineer. It is amply illustrated with cuts of work in progress and completed.—— Our thanks are also due for a copy of a superbly gotten up book "Descriptive and Illustrative of the Equitable Building, Denver." This building we have previously brought to the attention of our readers, and we need only speak here of the care exercised in the making of the present volume. It is finely illustrated, chiefly from photographs, and is a handsome memorial of one of the finest business blocks in the United States. It is to be regretted that the text is not on a par with the illustrations and the work of the architects, who are Messrs. Andrews, Jaques and Rantoul of Boston.

We have deemed it our duty to refer, from time to time, to the architectural and engineering abominations of Chautauqua, not because we are not in sympathy with the Chautauqua idea, but because we deemed it proper to expose the atrocities of Chautauqua village. It is with more than usual satisfaction, therefore, that we find our views supported by no less an authority than Mr. George E. Vincent, who has contributed an article on this subject to a recent number of *The Chautauquan*. The idea of Mr. Vincent's article is to expound the increasing hygienic advantages of the village, and he apparently labors under the impression that the abominations that have characterized it to the present year of grace were essential to its future growth. Such would have been the case in any ordinary community. But Chautauqua is not ordinary; it was built and organized with the stupendous idea of providing education, and the very best education at that, for the multitude. It had at the very beginning, therefore, an educational purpose and value which no other town has had, and should have been planned in the most healthful and scientific manner. Had this been the case, it would not have been necessary for Mr. Vincent to chronicle, as he does, the destruction of sixty cottages by fire in 1887, ten years after the village was started, and then only to become aware that "wooden buildings ought not to be crowded indiscriminately together, and that, unless some adequate water-supply available summer and winter could be obtained, the whole town was liable to destruction." It does not speak well for any body of men, much less public educators, to have needed ten years to get these elementary ideas through their heads. Nor would one suppose, did not Mr. Vincent vouch for it, that a lot of "cheap and unsightly shops and booths" could ever have been burnt there. But these things belong to the past. More important is the regeneration of Chautauqua, which is the real text of Mr. Vincent's article. Gigantic improvements are under way, including a complete system of sewerage, which, *mirabile dictu*, will be ready for the present summer. Yet as it has taken sixteen years to reach this, though nowadays no ordinary town is started in which it is not the first and most important consideration, the Chautauqua people have no reason to accuse themselves of undue celerity in their movements. We must, however, differ with Mr. Vincent in his statement anent "the substantial and artistic" summer homes which have been built at Chautauqua since 1889. There were no buildings in the village in 1892 which could by any possibility be called artistic, though doubtless they were substantial enough. We regret to learn, also, that the Assembly furnishes plans and specifications free of charge to all who wish to build. This policy should be at once revoked if any permanent and artistic change is to be produced at Chautauqua.



Conducted by Thomas L. Greene.

IN this Department it is intended to cover more especially the financial, commercial, and operating portions of the subject indicated by our heading. When we consider how large this railway question is, how important in its effects upon the national prosperity must be the right solution of it, as well as the many details involved which bear directly upon so many different professions and trades, we are easily convinced that in its many-sidedness it is worthy of the particular attention of specialists as well as of the general public. The proper management of our transportation lines calls at different times for a wide knowledge of differing arts and sciences; and a discussion concerning them will show the many places in which such questions also touch other departments of human thought and work. As an instance, let us take the so-called industrial companies. Of late we have been rapidly developing a corporation civilization. Corporations are forming to do what firms and partnerships have hitherto done. These "artificial persons" bring new questions to the foreground, as, for example, in finance; yet, if we study the history of railways and particularly of the great systems formed by the consolidation of smaller roads, we shall find many of the modern industrial corporation problems anticipated, and probably also dangers pointed out and a path of safety indicated. Then, too, the public side of railways needs discriminating attention. We expect "regulation," but what should it be? In no other line of commerce does legislation affect so many, both investors and employés. What legislation is fair and just; what the results of such and such laws are likely to be; what further statutes we ought to ask for,—these questions concern thousands. The rate problem in its many ramifications reaches shippers and civil engineers alike. Then again the art of operating a railway, aside from mechanics, involves important questions of judgment and of progress, these in turn having their direct influence upon bond interest and dividends. The field is wide. To the end that this department may be of direct interest to the readers of the ENGINEERING MAGAZINE the writer would be glad to receive from time to time suggestions as to lines of thought and topics for discussion. He has no pride of opinion, but will strive to present the facts impartially, with such comments as may serve to bring the merits of the case into clearer light.

THE Chesapeake and Ohio is one of the first American roads to print the annual report for the fiscal year ending June 30, 1893. The road itself is an object lesson in railway management. Five years ago the present owners took possession of a property practically bankrupt, without good equipment, and in very poor physical condition. By the judicious expenditure of money, received partly from earnings and partly from the sale of bonds, the whole railway has been slowly brought to a good standard. This change in the rails, road-bed, and equipment has allowed of longer and heavier trains. As the traffic tributary to the road is almost wholly of low class, paying but little per ton-mile, the problem resolved itself finally into the question how much could be got into a train; for this freight, though "cheap," is not limited in quantity, coal and coke comprising about fifty per cent. of all the commodities. The greater portion of the coal is carried at the extremely low average rate of 3.27 mills per ton per mile. The average lading of each freight train has increased from 225 tons in 1890

to 283 tons in 1893, the latter yielding $1.44 average earnings per freight train-mile in spite of the low average rate. The seaboard coal is carried a little over 400 miles from the mines at about $1.40 per ton and still at a profit, though the cars are returned empty, because the construction and condition of the plant are of the best and permit the most economical operation. To the trained eye these few figures show a record which admits of praise. But it is worthy of study also as showing the lines along which it is more than probable the successful solution of the operating of railways in the United States will move for the future. The commercial conditions of the transportation problem may be said to be set in the United States. Low average rates we must accept as a fact. The payment of interest and dividends depends upon the carriage of large quantities at low charges, but still at a profit, because of low operating expenses per unit. This latter term does not mean small annual wages per man, but that by means of the best appliances a larger and larger volume of business can be moved without increasing expenses in like proportion. This in turn means the liberal but judicious expenditure of capital at all places—such as the reduction of gradients—where a saving in operating expenses can be effected. In the Chesapeake and Ohio case the increase in train loads has been accompanied also by an increase in the number of trains and in gross earnings. The whole history and experience of that company for the past five years are worthy of the attention of all interested in the solution of cheap railway transportation in the United States.

THE paper in the September number of this Magazine, by Mr. James L. Cowles, on "Distance not a Factor in the Cost of Railway Traffic," deserves discussion. There is no doubt that the managers of our railways make too much of distance in arranging tariffs. As Mr. Cowles says, there is no appreciable difference in cost of running a train whether full or half full. The study ought to be therefore to provide good loads, and in the practical working out of such study the length of a journey is not, or at least ought not to be, the controlling factor; yet rather strangely it is difficult to make the average railway man abandon the old idea of fares arranged according to miles traveled. For an illustration we will say that commuters travel 25 miles to and from a city daily, while beyond the 25-mile limit of "short" trains lies a country desirable for residences but unoccupied. City men will not go there and pay double the 25-mile commutation. It is clearly for the interest of that railway to run express trains from the furthest section spoken of without stops within the limits already developed. The company should also charge a smaller monthly sum than the mileage proportion,—a sum not more than the city business man can easily pay. The result would be the building up of a steady suburban travel from a section which the mileage theory would keep unoccupied; and, as cost of terminals and tracks as well as bond interest is not increased, the earnings of these longer trains over mere movement expenses go to swell dividends. This very thing is done with milk, which is carried from all stations to the city at the same rate; why not more of the sort in passenger service? And so in other departments. The Hungarian zone system of tariffs, though not applicable as a whole to the United States, ought to teach us that our worship of distance is the worship of an idol. The arguments and statistics advanced by Mr. Cowles in support of this part of his contention ought to receive consideration from all railway managers and traffic men.

IT is to be feared, though, that the good points of the article will be lost sight of in the general disagreement on the part of railway men with the inferences and conclusions which Mr. Cowles draws. To say that distance should not control rates is one thing; it does not follow that distance can be eliminated from the problem altogether. In the first place the figures quoted do not always bear directly upon the question. For example, it is said that the load of the average passenger train is but 41 passengers. A more correct way of

putting the fact would be that the number of miles traveled by passengers is an average of 41 for each train mile; not a high average, to be sure, but one which throws little light (except as a hint for further examination) upon the question of train management. But the fundamental assumption of those who would apply the principle of the post office to transportation and charge each passenger or each ton a uniform rate regardless of distance carried is that the present average will continue to be the average under changed conditions. Averages have their uses, but we must remember that after all they are abstractions. Perhaps no train carried just 41 passengers; some had more and some less than that number. Now, the average fare paid per trip by each passenger in 1892 was about 50 cents, though many paid less than that and a few paid over a hundred dollars. Let us suppose 50 cents made the fare for all without distinction. The number of those who had been traveling short distances at 25 cents a trip would diminish, while the trains for long distances would be crowded. The average, on which the whole calculation depends, would be at once destroyed. Unfortunately, while loads do not affect train expenses, distance does. Fuel, enginemen's and trainmen's wages, repairs, and the like vary directly with the miles traveled. Practically therefore the passengers who paid but 50 cents for a trip from New York to Kansas City, let us say, would not cover those movement expenses, to say nothing of bond interest and dividends, though they might fill a long train. It is this distinction which Mr. Cowles misses when he says: "I have now demonstrated that distance costs practically nothing in railway transportation."

THE discussion now naturally leads up to the true principle in tariff-making, of which Mr. Cowles seems to have a dim impression. That principle is the old one, —to charge what the traffic will fairly bear. Take the passenger fares again. If we could ascertain what his journey was worth to each passenger and charge him that sum (of course within limits) for his ticket, we would fill our trains with travelers and our railway treasuries with cash. This would put distance just where it really belongs,—a factor, but not the controling one. A journey of twice the length is not necessarily worth twice as much to the passenger; this fact becomes all the more clear as we assume longer journeys; it lies at the basis of the Hungarian success in charging for 50 miles more than for 25 miles, but making nearly the same fare for 400 as for 300 miles. Of course this principle can never be fully carried out; but we are approaching it in various ways, by asking extra for a limited train and for a parlor car seat, by running (as in England) workingmen's trains, and by charging less in proportion for a through ticket if without the privilege of stopping over on the way. The difficulty is to keep high-priced travelers, who ought to pay well, from taking advantage of a cheap train intended for poorer men, since class distinctions are not favored in America. In the same way a classification of freight is intended to put a high rate on dry-goods in order that coal may be carried at a low charge, while yet the total revenue is the same. If dry-goods and coal were charged alike, the coal would not move. Now, the low average load for passenger and freight trains is not an argument for the elimination of distance altogether, but is an evidence that our railway managers have not yet solved the problem of apportioning tariffs in the way best suited to stimulate traffic according to the charge which each passenger or each ton may be expected easily and fairly to bear.

THE guaranty of the dividends on the Canadian Pacific shares by the Dominion of Canada expiring last August, the company must now depend upon its own resources for future dividends. In its last annual report the management professes to have no fear. Indeed, of late the company has distributed surplus earnings to shareholders in addition to the 3 per cent. guaranteed. Its cash balance records about $7,000,000 to its credit,—a showing very favorable as to the condition of its treasury. The company asked and ob-

tained permission to issue preference stock to the amount of $8,000,000 for the construction of lines hereinafter referred to and for improvements—particularly bridges —on the main line; this stock carrying priority up to 4 per cent. in dividends. The Canadian Pacific was built largely through the bounty of the Dominion, in order to secure a transcontinental line connecting the widely-separated provinces. It is a bit startling to find this railway proposing to abandon for through traffic a large part (about 2000 miles) of its old line in Canada in favor of a new road through Minnesota and North Dakota, mostly outside Canada and within the United States. To account for such a change in policy further discussion is necessary.

To put the matter in a word at the outset, we may say that Canada alone cannot support the Canadian Pacific railway. The population of British Columbia and Manitoba, through which the railway runs for a distance of nearly 1500 miles, is only 300,000 by the census of 1891. The same sparseness of population follows the line of the railway to Ottawa and Montreal, about 2800 miles from the Pacific. In the more settled parts of eastern Canada the traffic is greater, but at the utmost not more than enough to support the lines located there. The business of Canada, while conservatively conducted, is not progressing. The future of Canada is perplexing her best statesmen, for, in spite of great exertions for immigrants, the increase in numbers and in volume of trade is slight compared with the United States. Statistics of production and export might be quoted to show what practical railway men will draw from the figures already given, that people so few in numbers cannot furnish traffic enough to support thousands of miles of railway, even though the company has had large grants of land and money, with exemption from taxation. Without permission from the United States government to carry traffic from points in the United States through Canada to destinations within the United States, the Canadian Pacific could not earn fixed charges. With the earnings from its own lines (local traffic) secure to it, additional traffic, in accordance with well known rules, is a clear gain, even though carried at low rates. Hence the complaint so common among American roads "that the Canadian Pacific has reduced rates just enough to get the business." The statutes of Canada allow of any discrimination or preference necessary to secure traffic from the United States. In some cases that company can compete successfully with American railways on even terms. It is also a fact that low rates on the Canadian Pacific are of benefit to certain sections of the United States—particularly New England and the Northwest —where any interference with the privileges of the Canadian company is naturally, though illogically, objected to; illogically, because we ought not to treat a Canadian railway and a Canadian manufacturer on a different basis. Transportation of United States goods through Canada is carried on under the system of bonding, the obligation of which, under treaties with Great Britain, is in doubt and which is often attacked as favoring Canadian competition as against American railroads, especially under the burden of the interstate commerce law. A curtailing of Canadian Pacific privileges in this respect, if carried out next winter as is now threatened, would affect that company's securities unfavorably.

THE spring and summer have seen an unusual number of important railways put into the hands of receivers. In most of these cases the companies acknowledged the correctness of the allegations of insolvency brought against them in the complaints, and thus turned the proceedings into friendly suits to secure the protection of the court. The whole matter of corporation receiverships has undergone great changes in recent years. Originally a receiver for any firm was appointed in order to sell the property and close up the business. The Court undertook the winding up in order that every creditor might receive his pro-rata share of the assets, whatever they might be. Thus a receivership implied a stoppage of business. It is our boast that commercial law changes as commercial customs change,

though slowly and at a distance; for commercial law is but a crystallization of the commercial customs of the community. So, certainly, it proved in receiverships. Receivers were appointed for railways as well as for private firms. But railways cannot be wound up or stop running. They are under an implied contract with the public not to do that; and, being operated, the manager, no matter whether called president or receiver, must have a policy as regards rates, trains, and similar things. Moreover, a railway company cannot easily take backward steps; its receiver cannot allow creditors to seize some important part of its line because they hold an underlying lien, or permit another creditor to tie up equipment needed to fulfill the road's implied obligation to the public. Hence the logical outcome was that a company might itself plead for a receivership if it thought its interests endangered, or might consent to a complaint made through friendly hands. The late Mr. Jay Gould was the first to bring this doctrine forward, in the case of the Wabash railroad, and his contention was afterwards substantially confirmed by the U. S. Supreme Court. Since that time the theory of a receivership for a railway has gradually changed from the conception of a winding up to that of a kind of "protection" by the Court of the best interests of the company as a whole. Dismemberment of a system built up of various lines consolidated is thus avoided under stress of bad times. While it is a hardship for any bondholder to forego his bond interest and his legal rights perhaps at the time when he needs money the most, yet there is no doubt that it is better for him in the long run, while preserving as a receivership does, the unity of the property so essential to the operating of the road for the best advantage of the public at large. Hence, while a receivership for a railway is a confession of insolvency at the time, and is usually a surprise to those not well informed, yet it does not as of old mean a disastrous end, but a conserving of the property until times improve or a plan of reorganization can be agreed upon.

THE operating expenses of the Canadian Pacific have been so low as to invite comment. Its maintenance of way is under $500 per mile, a low average. Its cars and coaches do not cost for repairs as much as on older roads in the United States. It has been suggested that the usual expenditures have in reality been made and the money charged to capital. This cannot be true, though no doubt everything possible has been called an improvement; a better explanation being that items for maintenance and repairs are low now, but will be greater in the future when renewals become necessary. It is fair, therefore, to expect an increase in operating expenses. When we also consider the fixed charges which are increasing every year rapidly, we see how great must be the pressure for an increase in traffic to support the capitalization. If our reasoning be correct, this traffic increase must come mostly from the United States in competition with American railways. If anything—Congressional legislation for example—should check this increase, the Canadian Pacific would of course be affected adversely. In spite of its apparent injustice, Canadian railway competition with United States roads is now so firmly established that it is not likely to be broken off completely; it may, however, be subjected to more severe restrictions, together with some legal relief to the American rival lines. The Canadian Pacific is "playing for high stakes," a game whose hazards must make uncertain the outcome as to the continuance of dividends on the common stock.

Conducted by Albert Williams, Jr.

AT the present time the main interest in mining circles is to guess at what is to become of the silver mines of the United States. Such of them as carry gold in appreciable quantities may be able to continue work in any event, using the gold as a mainstay and the silver as a by-product. Another class of so-called silver mines yield lead ores, which may run low in silver contents, and hence be used in silver-lead smelting for fluxing dry ores, or may carry enough silver, or silver and gold, to furnish a true precious-metal ore. Then there is still another class, the copper-silver mines, like some of the mines of Butte (Montana), which might rely upon the copper and handle the silver (of the copper-silver matte) as a by-product. Finally there are two or three, or three or four, mines so rich that they could have withstood any reasonable reduction in price of product. Altogether, silver-mining is not going to be entirely stopped, for there are too many mines which produce, in addition to their silver, either gold, lead, copper, or some combination of those ores, which will enable them to exist somehow. But the immediate outlook for silver-mining is indeed gloomy.

PROBABLY the best chance for the new crop of prospectors is to relocate some of the old and abandoned low-grade gold-quartz propositions, that would not pay in earlier times when all expenses of mining and reduction were so much heavier. The writer has in mind a big quartz ledge, on which a fatuous Boston company put a 60-stamp mill, sometime back in the sixties,—this mill being housed in a stone structure and to be trailed all along the road by the usual abandoned experimental machinery of those days. There was one fault with the mill. It had no water. To properly develop that mine would require building a narrow-gage railroad some 18 or 20 miles to a river. So far nobody has had the assurance to put in the quarter of a million dollars requisite to make another Homestake, though a whole procession of prospectors and coyoters have at different times jumped the best parts of the lode and struggled along with a one-mule arastra and pickings.

THERE is one gleam of comfort in the general demoralization of silver mining and its adjunct industries—and that is the increased attention paid to gold mining throughout the far west. While many thousands of discharged silver miners have gone east or become day laborers, others have drifted to the gold mining camps or have struck out into new territory in the search for the yellow metal. The prospecting season is nearly at a close in the mountains, but there is time yet for important strikes to be made.

UNFORTUNATELY for the new army of gold-seekers, most of the country has been pretty fairly prospected for gold long ago. Whether it be placers or gold quartz, the indications are comparatively simple, as against those of the complex silver ores; and for thirty or forty odd years, according to locality, other prospectors have been traversing the gulches, panning the creek sands, and looking sharply for gold quartz float. It is hard to find any region in this country nowadays that has not been overrun long ago by the gold hunters.

IT may not have occurred to most mining men that there is an immense difference between low-grade and lean ores. Mr. Richard A. Parker, who will have something to say about the Lake Superior

iron ores in this magazine, calls especial attention to this distinction. When one is called upon to face a problem of handling auriferous iron pyrites, this difference in definitions begins to make itself practically felt. For example, suppose you have a three- to five-foot vein of iron pyrite, almost solid from wall to wall, but only running an ounce or a fraction of an ounce gold per ton, and situated in a place where the conditions are all against economical milling or chlorinating, and from which transportation cost is excessive. That is a low-grade ore. There is no use in concentrating it. Now, on the other hand, suppose that the three to five feet of vein matter consist of narrow streaks of high-grade ore, with intervening bands of barren gangue of some sort,—quartz, clay, talc, or what-not. Here is a proposition admitting of concentration on the spot and the shipping of high-grade concentrates to a distant smelter. The same rule holds with other classes of ore. It makes a big difference. Few miners realize it.

PROBABLY most mining men have at one time or another heard of "placer silver," and have very reasonably doubted the existence of such a thing. It is not believed that metallic silver in the form of fine grains, scales, or wire and dust can exist long when exposed, as it would be in shallow placer gravel, to the oxidizing atmospheric influences. It is true that some rather large masses of native silver have occasionally been encountered at and near the surface of the ground, but, so far as known, always tarnished and blackened on the outside and showing evidences of exterior oxidation, which in the course of time would mean a gradual solution and removal of the metal through the agency of saline solvents in the water. As a general thing, however, mines which carry native silver are not likely to show much of it in the croppings, but only in depth, where the vein is solid and protected from surface meteoric influences, as under the permanent water level. Yet there are those who believe in the occurrence of native silver in placers, in the state of fine grains and dust, corresponding to the common type of placer gold. The inventor and backers of a new amalgamating and concentrating machine are so enthusiastic over its merits that they claim to save by it large quantities of this placer silver, which they say is present in important quantities in the auriferous gravels and only escapes retention and notice because so fine and light that the rival machines and appliances cannot catch it. This machine is a combination of amalgamated plates with movable riffles; it has a trap at the lower end; is loosely swung by adjustable rods from a fixed frame, and is given a shaking "pan-motion" (somewhat like that of the common hand pan) by means of a rocking rod operated by a crank and gearing. The riffles are of sheet iron with rubber edges beneath, so as not to scratch the plates. It is intended as an adjunct to gold mills as well as for treating screened placer gravel. They claim that the amalgam taken from the plates often carries more silver than gold, and exhibit buttons of each metal obtained after retorting and parting,—which of course to the skeptical engineer is about as convincing evidence as the sight of the tons of rusty spikes exhibited in European cathedrals would be that they are all nails from the true cross. But while the new machine may work very closely, it has not yet demonstrated the existence of the supposititious placer silver. There are several ways in which it might be explained how large proportions of silver might be obtained in such an apparatus without resorting to the naturally suggested suspicion that there is any humbug about it. All native gold contains more or less silver, from the exceptionally pure 975 thousandths placer gold, down to cases running 700 thousandths and under. In such gold the 25 to 300 thousandths or more of alloy is practically almost all silver. Then there is the "white gold" of both placers and quartz veins, sometimes worth as low as $12 an ounce on account of the large proportion of silver in the alloy. Even the gold tellurides and native amalgams always carry some silver. At Bodie, California, this "white gold" has also been called "electrum" or "electron,"

in allusion to its pale amber color, though it is sometimes almost dead white. Such gold resists oxidation, and it is easy to imagine extreme cases that would give support to the placer silver theory, though as a matter of fact in the region where the tests were made it has not yet been recognized. Then a close-working machine might catch silver amalgam that had escaped from silver mills working above it, which amalgam is known to be often carried long distances in suspension in the streams, even to twenty and forty miles below the mills. In the present case there were no silver mills above some of the places tested. Or possibly the quicksilver used in amalgamating the copper plates might not have been retorted. Possibly there are other explanations. At any rate the case for placer silver cannot be said to be established until more systematic tests are made, with due precautions against error and salting. Assaying is out of the question with placer dirt in bulk, but careful panning of large sample lots of gravel and sand by the two-pan method (which is probably a more delicate test in skilful hands than any other), followed by a microscopical examination of the pan concentrates and assays of the latter, would soon settle the matter, at least in a negative sense as regards any particular locality. Meanwhile, pending such an examination, we are still in the dark as to whether "placer silver" exists or not.

IT has been ruled by the court of appeals in Colorado that, where a person who has located a mining claim permits an adjoining occupant to patent that part of his claim on which is located his discovery shaft, the remaining portion thereof reverts to the condition of public lands, and is relocatable; and such rule applies, though the patentee made his location after such person.

Another recent mining decision of interest was rendered in a suit against an Idaho placer mining company. Under the statutes of Idaho, the party or parties owning a majority interest in a mining claim or mine, in the absence of any specific agreement to the contrary, have the right to the control and management of the same, subject to the laws of the United States and of the State. Where a mining corporation works a mining claim in which it has a minority interest, against the protest of the majority interest, and mingles with the gold extracted therefrom a portion of gold from its own claim, without the consent of the other party, and the quantity and value of such portion is unknown, it cannot recover the gold so mingled.

IT has always been a difficult matter to dispose of small lots of unusually rich gold and silver ore at their full value, unless they happened to be of particularly showy appearance, and therefore could be sold at fancy prices as specimens to dealers in cabinet minerals. Latterly some establishments in the west, engaged also in sampling and testing ores, have been making a specialty of the trade in these small rich lots, for the convenience of sellers and mutual profit. The large smelting works as a rule decline taking ore in quantities of less than five tons, and the custom has been for the sampling works and ore brokers to accumulate these smaller consignments until they have a salable lot, then mix them, and turn the mixed lot over to the smelters. Now much of the extremely rich ore is being reduced on the small scale by special processes.

IN looking over the "personals," a column of which is published in most of the mining journals, one cannot fail to be struck with the numbers of notices of American mining engineers now engaged in various distant mining regions of the world, notably in South America, Australia, and South Africa, either as superintendents or as examining experts and in consultation. It is something to be proud of that in so few years we have passed from the stage where this country had to rely upon foreign technical talent and skill, or upon foreign-educated Americans reimported, to a point where the services of American mining engineers and metallurgists are recognized and in demand elsewhere. It may be a national trait and re-

proach that we can't help everlastingly bragging; but here is something to brag about. It is observable, too, that our engineers generally are better paid abroad than at home.

AN improvement in the endless traveling rubber belts used in the type of vanners of which there are now so many varieties consists in making the edge flanges of the belts incline at an acute angle toward the center. This form enables the belts to pass over the end rolls or drums without breaking or cracking. Another recent modification is the introduction, at intervals of about two feet, of a series of small transverse riffles (twenty, each the one-thirty-second of an inch in depth), extending over a space of about one inch across the belt. These riffles are intended to save floured sulphurets and amalgam that would not remain on a smooth belt, and to prevent channels being formed and the pulp from packing at the edges. The new rubber vanning belts thus combine the features of the standard smooth belts and the continuously corrugated belts.

TWO measures have been pending before the senate in favor of the State mining schools of South Dakota and Colorado. The senate committee on public lands has agreed upon a favorable report upon Senator Pettinger's bill granting to the State of South Dakota 50 per cent. of the proceeds of the sale of mineral lands of the State for the maintenance of the State school of mines. In South Dakota they have some gold mines—and big ones too—which may possibly be benefited by the State mining school. But it is to be wondered what is to be the utility of the numerous mining schools of the country if half the mines are to be kept closed, and what chance of employment their graduates will have in the same contingency. Senator Teller, however, does not seem to have lost faith in the future of the mines, or the utility of the mining schools, for he has reintroduced the Golden school of mines bill, similar in provisions to the old bill, which proposes to aid the school with 25 per cent. of all the money recovered for mineral lands, limiting the same to $12,000 per annum.

The plain truth about mining schools in the United States is that there are too many of them,—too many inefficient ones. They all attempt to give a "high science" education which only two, or at most three,—it would be invidious to specify,—are prepared to furnish. It requires as big a capital to install a mining school with apparatus and teachers as a great smelter with furnaces and railway tracks. It also requires something else,—maturity and reputation, so as to attract a promising class of students and a faculty that have some reputation. The character of the students has much to do with success, owing to retroactive influence. The usual run of "professors" in the country technical schools are men who have been unable to do better work or secure higher pay. As a general thing, when a man is incompetent to do the thing he starts out to do, some board of managers picks him up and employs him to teach a lot of innocent, unsophisticated boys—how not to do that thing. So we have pedagogues and not engineers in charge of American mining schools.

If a boy wants a thorough technical training in mining and metallurgy, he had better take the usual academic course in one of the half dozen real universities (not in one of the three hundred pretences), and then go through the regular curriculum of one of the two or three mining schools that have the proper facilities and teachers. If he simply wants to learn the fire-assay and rough transit work, he can probably *be paid* while he learns; or at the worst go into some large assay office or surveyor's office and put in his time for nothing. You can teach a Chinaman the fire-assay in about a fortnight. The whole trick is in the use of the balance; the rest is plain cooking. Or, you can teach an intelligent ax-man or rod-man how to handle the transit or level in about the same time.

But if you want to train a boy in a deeper, broader way, so that the general principles of physics, mechanics, chemis-

try, geology, mineralogy, etc., can be grasped, why by all means give him a course in the most advanced schools—if you can afford it.

EVERY once in a while a reprint newspaper item is met floating about in the current of patent inside or patent outside or syndicate or block literature, concerning the treasures in gold and silver that exist in sea water. Exactly what the truth of the matter is we do not know, but, as the alkaline chlorides are solvent for both metals, in small quantity, the chances are that both are contained in the ocean, since the streams cutting through mineral veins all contain a little chlorine, iodine, and other solvents, no matter in how slight proportions,—and there has been plenty of time for concentration in the oceans. As to the analyses, they are mostly imaginary or doubtful. To detect a fraction of a grain per ton of gold or silver in the presence of the mass of alkaline salts is a delicate matter. Probably the use of amalgamated copper plates would be a better test than any concentration and analysis. The following extract however may be interesting:

All salt water contains a small per cent. of gold, says the Salt Lake *Herald*, and Capt. Davis, after numerous assays, satisfied himself that the water of the great lake carries $3 a ton in gold. After four years of experimenting, Mr. Davis has invented a method to extract the gold at a cost not to exceed 40 cents per ton. He estimates that there are 15,000,000,000 tons of water in the Great Salt Lake, and that it carries $45,000,000,000 in gold. To save this by using the method Mr. Davis has devised will cost 50 cents per ton, or $7,500,000,000, leaving a net profit of $37,500,000,000, the same being ten times more than the entire amount of gold money in the world.

ONE of the signs of the times is the remarkable depression in the iron blast-furnace output. The *American Manufacturer* (Pittsburgh) says that such a remarkable cessation of activity among the furnaces was never known. Even in the summer of 1891, when a concentrated shut-down action was undertaken by the furnaces in the Shenango and Mahoning valleys to bring the railroads to better terms on freight rates, and when the supply of coke from the Connellsville region was almost totally shut off by a strike among the workmen and furnaces were compelled to bank or blow out, even then the number of active stacks was much in excess of their standing on the 1st of August, 1893.

The same authority, to show how general the stoppage has been, appends a list of the districts in which iron furnaces have gone out; with the number of such stacks. It runs as follows: New York, 2; Pittsburgh, 3 iron and 2 spiegel stacks; Shenango valley, 2; Juniata and Conemaugh valleys, 3; Maryland, 3; North Carolina, 1; Mahoning valley, 3; Eastern, Central, and Northern Ohio, 5; Hocking valley, 1; Hanging Rock, 5; Alabama, 6; Indiana, 1; Illinois, 3; Missouri, 1; Colorado, 1. Virginia is the only State showing an increase of 1 bituminous stack in blast.

The iron and steel—consequently the coal, coke, and charcoal—trades are peculiarly sensitive in times of monetary stringency. Probably the best index of the financial condition of a country would be obtained by turning to these trades, and not to the banks, the insurance companies, and the investment and trust concerns. Preceding every panic the production of pig iron and its derivatives has always been large. But at the instant of doubt and insecurity it comes down like the mercury of a thermometer in a blizzard.

THE most complete list of returns of mining companies that we have been able to find shows for the first half of 1893 a total of $5,699,025 paid in dividends. This list is made up mainly of gold and silver mining companies, but it contains also some of the iron and copper mining companies of the Lake district. The reported earnings and dividends of the incorporated mining companies do not include the large number of single profits made by private companies and firms and individual owners. This good showing, in spite of hard times.

MACHINE SHOP PRACTICE

Conducted by Albert D. Pentz.

TELL a man just how by an unfamiliar process a thing is made, and he is interested at once. This is the secret of successful writing in all descriptions of technical operations; and the writer who is also able to make himself understood to men who are ignorant of the art described is sure of an audience. He may tell that which is commonplace to some of his readers, but let it be new to the general reader, written clearly and within his grasp of language, illustrated by a comparison of its processes with those familiar in ordinary experience, and more people will be interested than there would be if that writer should be able to demonstrate the quadrature of the circle.

ARTHUR'S furnace case hardened all right in its dilapidated condition, but he was not satisfied with it because it was in constant danger of falling to pieces. So it was rebuilt. Now it does not work well, although the heat is uniform and high. The work comes soft and irregular in hardness. Sometimes a piece will be hard on one side and soft on the other. Occasionally a piece will be cracked at one place and annealed at another in the endeavor to get good results. Arthur won't believe that the lime in the new mortar and perhaps in the brick can do this and will continue to do so until they are thoroughly burned out.

SULPHUR or sulphuric acid is, one of them opposed to the hardening of steel. In the processes of cold rolling and in the cold drawing of sheets and bars it is necessary to remove the scale, and this is ordinarily done in acids containing sulphur. This acid may be killed, but in most such cases there is a sufficiency left at the surface of the metal to prevent such surface from hardening as it should. Thus frequently it is noticed that a tool or part is soft at the surface but hard within. Screw rods coated in sulphate of copper have this defect more conspicuously than most other kinds of material.

IN turret machines, if the cutting edge or point of a tool be so placed that a slight difference in the position at which the turret is stopped in cutting position will affect the sizes of the work greatly, that placing of the tool is wrong. Such a tool should be set so that its edge holds a relation to the turret such that, if the turret be turned on its axis, the cutting point will cross the surface being cut on a tangential plane, and not come closer to the center of the stock than the size of the cut demands.

AS to oil channels: It is my belief founded on extensive practice that oil channels are neither the best nor the most practical means of distributing lubricants to distances from reservoirs and over extensive surfaces. Channels notoriously accumulate the dust which may come to them from every source, especially that which is abraded by friction from the surfaces being lubricated. This dust and viscous parts of the oil soon fill up these channels, especially in places where the oil is fed automatically to the bearings in minute quantities, and instead of a groove there soon becomes a channel filled by a pasty or hard mass of a very dangerous character, ready to cut the surface of the bearing whenever it may be washed out with benzine by the person noting the obstruction.

In place of channels every bearing or journal should be fitted as freely as is necessary to admit sufficient oil to keep

the surfaces apart, and no freer. Between slow moving surfaces one thousandth of an inch is quite sufficient for this.

CASTINGS rusted red will paint better and not scale as much as those in other conditions of surface. On the contrary, the grey surface left after castings are pickled and dried frequently comes off and leaves a bare spot.

ALL pickled work should be very carefully treated before it is either japanned or nickeled; otherwise the coating will peel off. The best treatment is a hot soda or potash bath, then a clean hot water or steam bath, and then a thorough drying in a hot oven. Care must be had, if a water bath be used, to renew it quite often, as it soon becomes too alkaline and deposits when dry on the surface an objectionable film which prevents a close union of the plating or varnish.

THE greatest fault practiced by impractical buyers is that of initial cheapness. To such a person oil is oil and coal is coal, irrespective of the quality or the source of the product. The cause of their being impractical buyers is that old cause, "talk is cheap," and the fluent person often gets a position he is qualified by neither nature nor experience to fill. The effect of buying cheap is simply an abomination. Tools on screw machines refuse to do more than one half work with any except sperm or lard oils without destructive wear, and on milling machines the results are little better, and consequently what may be saved in price of the oil is lost many times over in wages and tools to do the work.

THE actual producer often becomes subject to the talker. In a certain factory, perhaps seven hundred miles from Chicago as the crow can fly, there are and have been plenty of first-rate mechanics, some of whom have good executive ability and all of whom are producers of good work in paying quantities. It has been the practice in that factory until recently to promote good workmen to be foremen and thence higher. Again, this practice has been a paying one, and that factory has been and is a most remarkable success in every sense. Recently, however, and covering a period of perhaps five years, there has been a disposition to subordinate the practical producers to accountants and other clerical people whose previous duties were to keep account of the work the mechanics performed. The most recent promotion in that factory is that of a clerk ignorant even of the names of the parts he is supposed to manufacture,—a person who does not know a monkey wrench from a vernier caliper. He however is a voluble talker, and the prosperity of that factory has so far removed the management from the workshops that accountants alone of all the hundreds of employés can get the ear of authority; hence the good talker gets the best of the good worker, and in time becomes his superior officer. It indeed must be a golden prosperity that can stand such treatment as that.

FEW factories run with less loss of power than thirty per cent., and this loss occurs whenever the engine is run, whether there is any work done or not. It is presumed that in the ideal future every tool and machine will be provided with its own electric motor; in the meantime, however, it is thought that a great deal of power may be saved by transmitting it to all shafts at a distance from the source of power on electric wires directly to a system of jack-shafts each of which should be provided with a motor of its own. It is certain that this plan will save one half the lost power, if properly carried out. Most shops of considerable size can save the cost of dynamo and motors in one year.

IN an experiment get the result to work by the first mechanisms you find to answer the purpose. After the device works successfully, many other different movements and principles will be found by experienced manufacturing mechanics to remove crudities and get positive results with certainty.

WITHIN a barber shop on Myrtle avenue, Brooklyn, there are a number of gas

burners suspended from the ceiling in the usual manner. Over each of the burners there is a porcelain arrangement to protect the ceiling from the heat of the gas flames. These protectors are suspended from the ceiling by chains and hang freely about two feet perhaps above the jets. Now every time the gas is lighted and the heat becomes considerable these pendent protectors commence voluntarily to oscillate quite vigorously, some of them more and some less. The length of each pendulum being about one yard, it is presumed that each oscillation consumes less than one second. The arc of oscillation in some extreme cases seems to reach about thirty degrees, showing that considerable force is developed by the flame. Now of course it is admitted that the heat of one of these jets may develop many times the force required to oscillate these reflectors, but how in this case did it do it.

IN designing machinery seek positive motions and avoid springs wherever possible.

DE GREE, during his recent vacation, bought a book entitled HOW TO RUN A FACTORY WITHOUT EXPERIENCE, and on his return he showed it to Mr. Blunt, telling that gentleman that he expected to gain considerable benefit from the information contained within its pages. Mr. Blunt, however, took no pains to conceal his contempt for the book, merely asking whether it had been written by some manager of great experience. Mr. De Gree admitted that the writer had not had any successful factory experience whatever. "There is no substitute for ability in factory management," said Mr. Blunt, "any more than in any other art requiring original work. You will remember that I object to specific factory rules, because of the obstinacy of men who never can be made to commit offences that exactly fit them. So I object to rules for management, because nothing comes up to be managed in such a way that the rules help much. It is a remarkable fact that old maids write the rules for managing children, and that most of the books for managing industrial concerns are the work of inexperienced men or of failures. If there be a man living who knows just what to do in every commercial emergency without specifically calculating that special emergency on its special merits, then that man is worth any sum that he may choose to ask for his services and get it too. Have you never wondered why the marvelous clairvoyants who advertise in the papers do not speculate in Wall street and get rich, instead of telling fortunes at fifty cents a head?"

A MAN'S ability is more surely gaged by marking how successfully he emerges from an emergency than by any other means whatever. There are many men who by taking thought and plenty of time can patiently do many wonderful works, but the man who can engineer a breakdown so that it is made to run till night and have it all repaired so that it can be started on time in the morning has the quality that wins battles and gains success in every sphere.

CONTRASTED to this kind of man is he who never is satisfied with the condition in which he is placed; who never gets the stock he requires or the tools needed for his work; who is always in the drag with his product, and who as continually seeks to fasten the responsibility for this on the acts or shortcomings of others.

THERE is no other way so good to emphasize a fact as to reiterate it. Thus there is no other means so good to cool a hot box as to pour on it alkaline or soapy water. The best way to make such a lubricant is to take about five pounds of tallow and perhaps two ounces of caustic potash. To this put about one quart of hot water, and then with a jet of hot steam reduce the soapy mass to the consistency required. This lubricant is certainly the most satisfactory one I have ever used where hard duty is required.

SUPERINTENDENCE is not only the getting of results personally, but the faculty of organizing the whole force so that every

man in a responsible position is interested in the getting of results also. The doing of this requires no special ability, but it necessitates that the superintendent shall be a man who can recognize and appreciate valuable service, and reward it in such a manner that the recipient of the reward sees in it an encouragement to still further exert his force and to urge the work in his charge forward to a more economical result.

ORDINARY boiled linseed oil is the best varnish known for cast iron surfaces. Of course the metal will not absorb the fluid as wood does; so the whole of the gums contained in the oil remain on the surface, where it is hardened by evaporation. It may also be a fact that there is some union between the metal or some of its impurities and the oil, for certainly it dries very soon and very hard. Few persons know how rich a surface a casting can have until they have experimented with it. A casting with a good surface pickled and washed with warm water or steam will be a rich brown. One pickled and not washed will be a peculiar grey, and one pickled and washed with cold water will be a brilliant red. Care must be had to not file or chip such castings more than necessary, and to never attempt to improve the surfaces left by the sand, as that surface cannot be improved in artistic appearance by filing.

DRILL jigs are pretty good as indicators of the experience of a mechanic in designing tools for efficiency. If a jig be made like a dark pocket into an end of which the part to be drilled is shoved, then there can be no good results got from it, for it can be neither cleaned nor kept clean, nor can it be known whether it be clean or not. Next to equalizing the work, to keep it from being sprung in fastening, the keeping of it and its supports with no dirt between them is of the greatest importance. To know there is no dirt on the seats in a jig is quite as necessary as to know that the drill is of the correct size, for in machine building nothing can be taken on faith. Therefore, when the jig is empty, every part of its seat must be so placed as to be seen, and the parts that obstruct the observation of them and the cleaning of them must be removed whenever possible. Very frail and springy parts must have the most rigid jigs, while other stiff and solid pieces may well support the jigs that locate the holes to be drilled in them.

DRAWINGS are good, but models are better. If only one of these elements can be had, let it be models of the parts to be manufactured.

LARGE bright surfaces are not so effective in appearance as large painted surfaces relieved by narrow or small bright edges or spots.

DOWEL pins cannot satisfactorily be drilled in the jigs within both of the parts they are intended to locate in exact position the one on the other. The most satisfactory way is to drill the outside part in the jig and to transfer that to the other when they are assembled. This refers more particularly to large or medium machinery, and where exact results must be obtained. In watches, however, and very delicate instruments, where enormous quantities are made of very small parts having short dowel holes, these may satisfactorily be drilled in perfected tools before they are assembled.

IT is possible that there is a mechanical power in elasticity, and that this power is neither of the lever principle nor of the wedge principle. Thus, if a number of pieces of soft india rubber be placed the one on the top of the other, and if when in that position it requires eight pounds placed on the top of all to depress the pile one inch, then, if the pieces are all alike in every respect and if they be taken down and placed on a plane surface with weights on them covering and depressing all alike, it will take sixty-four pounds to depress them, as a whole, one-eighth of one inch, which is exactly the amount, one-eighth of an inch each, that eight pounds depressed them in the first position when they were in one pile eight layers high. Thus it will be seen that the ratios of power required

to depress each of these springs a given distance is exactly proportional to the distance which the weight has fallen, as in the case of a lever or a wedge. A coiled spring regularly wound and cut into sections of equal length shows this same peculiarity, as also will a series of flat springs. I am not now able to apply the advantage thus gained to useful purposes of mechanical value, but that may be because this phase of the subject has but recently interested me. It is certain, however, that the elastic principle contains a mechanical power, and that it to my knowledge has not been noticed before.

ONE fact, however, is demonstrated by this spring problem, and that is that the stiffness of a coiled spring is inversely proportional to the length of wire it is made of, all else being equal. In fact, many things may be unequal, and the stiffness of springs will remain thus proportional to the length of the wire they are made of.

THE subject of files becomes again and again one of paramount importance, for it is a fact that there are no files made in this country that are at all comparable to those made by Stubbs in England. This is a disgraceful fact, for in no other art are we so far in the rear of European countries as in file-making. It is not alone quality of the steel,—and that is bad enough, some of it being bought for about four cents per pound,—but the cut is weak, being unsupported behind the edges or points of the teeth. I believe files could be milled better than they can be cut by any other process, and thus the best shape of teeth may be made with certainty, economy, and ease.

THE proprietor of one of the most successful of enterprises located near New York city in a recent conversation stated his conversion to the belief that "a strict military discipline is best by which to govern a factory." He further states in substance that in his works he had found that there could be no real efficiency if he gave orders except through his manufacturing superintendent. He found that, when he, innocently enough, instructed his men directly, they presumed on the fact and became disrespectful to their immediate superiors. The men also made a practice of boasting of the notice they received from the proprietor and of the fact that they got their instruction from him, showing that they had a contempt for those directly above them. Another effect of this was that superintendents became discouraged and did not take the interest which they should and which they now do since the change in the proprietor's practice is to give orders to them directly.

MY friend Thomson manufactures a small specialty, but his principal work is jobbing. One of his customers, who supplied him with a reasonable amount of business, began about a year ago to agitate for a better price, so that he could meet the competition more successfully.

Thomson in the pride of prosperity refused to do this, yet the customer continued to patronize him, under protest however. Now after the panic has come the customer has no difficulty in getting his work done at another shop as cheaply as he desires. Thomson is profanely and abusively indignant at being forsaken by "that man whom I stood by for years and years. Now he leaves me just to get his work a few cents cheaper. He gave me no warning, but just took his work away and gave it to that red-headed scalawag from Hartford. Bah!"

CURRENT TECHNICAL LITERATURE

THE LAW OF INCORPORATED COMPANIES, OPERATING Under Municipal Franchises. By Allen Ripley Foote and Charles E. Everett, with a resident attorney in each State as co-editor. Cincinnati: Robert Clarke & Co. 1892. [Three Vols. Law Sheets. $15.]

THIS is a valuable work, which has been produced only by great labor and at large expense. It consists of three handsome volumes, of nearly 3000 pages, and represents the work of forty-eight contributors extending over a period of three years. The subject thus carefully treated does not include the whole range of corporation law, but is confined to the law of corporations, operating under municipal franchises. In other words, the branch of law covered is that which applies to corporations formed to carry on business under some municipal grant, as, for instance, a gas, electric-light, telephone, street-railway, or water company. The aim of the authors in treating this subject has been three-fold: (1) to determine from an economic standpoint whether these public enterprises shall be carried on by corporations, and, if so, how these bodies shall be controlled; (2) to outline the distinctive features of the general law now applicable to such corporations; and (3) to present the existing law, whether constitutional, statutory, or judicial, in each one of the States upon this subject, so that a comparison of methods and laws may be readily made for the common good. These separate aims have caused a division of the book into three parts.

The discussion of the economic principles that control the subject is conducted by Mr. Foote. It is an earnest and interesting plea for a change from the existing methods of granting municipal franchises and in behalf of the adoption of an entirely new plan. The plan proposed contemplates the establishment of a department of government to be known as the Department of Municipal Administration. This department, according to the author, should have supreme control of all municipal highways and of all corporations desiring the right to use them for any purpose. The charters of the companies should be issued upon certain specified conditions, and the State and the corporations are to go into practical partnership in the conduct of the business in reliance upon these conditions. The new department, it is claimed, should have the powers of a court, and all questions between the corporations and their users should be disposed of by it; it should also be authorized to require the most searching reports, and should have access to the books of the corporations at all times. Provision is made for a division of profits between the State and the corporations, and the many benefits that would probably result from this new order of things are pointed out. But the objections to the scheme are not given equal prominence. Aside from the fact that many will strenuously object to it because it is a plan for absorbing the attention of government with work that private enterprise will manage much more effectively and which is beyond the scope of the government unless demanded by public necessity, it is quite evident that municipalities will not readily surrender to the State the right to grant these franchise rights. Moreover, the street-railway, telephone, gas, and other similar corporate bodies surely will not be eager to put their interests in the hands of a partner, who is a sharer in profits, a judge of all questions that may arise in the future, and a legislator with power to make laws to suit his own convenience. With such a partner the rights of the corporation would be indeed slender. In our judgment investors would not put their funds into undertakings where the returns upon their investment were to be decided upon by the emissaries of the State who

were occupying the chairs in the Department of Municipal Administration. And corporators would not for a minute tolerate such inroads upon their private rights as would be necessary to carry out a scheme of this character. To us the whole plan of the creation of such a department of government seems impracticable and unnecessary, and, although no doubt evils may be detected in the systems of granting public franchises now in vogue, these evils should be remedied without this wholesale destruction.

The second portion of the work contains a general view of the law governing the subject. This is well written and shows careful investigation. Many authorities to sustain the propositions of the text are also cited in the foot notes. The following chapter headings illustrate the scope of this discussion: (1) Introductory; (2) historical; (3) constitutional limitations; (4) powers of State legislatures; (5) public use—public policy—vested rights; (6) franchises; (7) streets and highways; (8) monopolies—conflicting grants; (9) municipal corporations; (10) franchise companies—individual rights; (11) conclusions.

By far the largest portion of the work is given up to the third part, which contains exhaustive statements of the law governing these corporations in the different States. These contributions from the pens of lawyers throughout the country contain much that is of historical value in relation to these corporations, and the compilations appear to be made with much care. The presentation of the laws of Massachusetts is particularly noticeable for its careful research. It may be noticed that with the rapidly changing legislation of recent years it is impossible to give all the latest laws in a work of the character of that now before us, and one must examine the session laws of 1892 and 1893 before he can feel sure that he has all the new acts before him. This is a matter of much importance in the State of New York, for in the chapter devoted to the laws of that State numerous provisions are quoted from the General Corporation Law and the Stock Corporation Law of 1890 which are no longer in force.

The work is excellently printed and bound, and as a whole it is calculated to serve most useful purposes in quickening thought in relation to the problems surrounding the control and management of these corporations, in bringing within the reach of all investigators this large body of legislation for comparative study, and in giving the busy lawyer the statutes and decisions of the different States upon this subject in compact shape.

DWIGHT A. JONES.

THE RAILROAD QUESTION. By WILLIAM LARRABEE, late Governor of Iowa. Chicago: The Schulte Publishing Co. 1893.

MR. LARRABEE, while Chief Executive of Iowa, was known as the anti-railroad governor; he seems to have kept up the character, for the present book is not so much an argument as a screed against railways. It will not be contended that our transportation history has not developed commercial wrongs, but it is certainly a misstatement of that history to put forth such a book as a discussion of "the railroad question." Mr. Larrabee seems to have read all the literature published in English adverse to railroads, and to have taken from them a long list of alleged grievances. If he mentions anything favorable, it is but to argue at length against it. The German and French literatures on the subject are scarcely referred to. The reader does not need to be told that such a method of discussing this or any other political or economical problem has no value whatever and must defeat its own purpose. It would be a waste of time to take up seriatim the charges brought against railroads of monopolizing, combining, subsidizing the press, corrupting politics, watering bonds and stocks, ruining farmers, and the like. Admitting that there is an atom of truth at the bottom of some of these alleged grievances, we need a calm consideration of the whole question if we are to find a remedy, supposing that to be our object. Shakspere's phrase "there is some soul of goodness in things evil" is as applicable to transportation as to morals. Salvation does not consist in obliterating morality, but in perfecting it.

So in commerce: the wise leader will with the bad consider also the good, that he may make perfect, not destroy. Some shippers are injured by unjust discrimination, we will say, yet on this account to repress the agencies without which the farms in Iowa would be worthless would be a commercial sin; to hamper them in their work of benefiting the nation at large would be fatal. To remedy the first-named injury by restricting the usefulness of the whole system of railways would be absurd. Our railway problem is admittedly a hard one in many respects, but no help is gained in writing or in reading such a book as the one under review. It does not require detailed refutation of the many false positions taken; indeed it does not need notice at all except that the readers of this Magazine may know beforehand its worthlessness, and that even the citizens of the ex-governor's own State may not be misled into supposing that the writer of the book has really discussed "the railroad question."

T. L. GREENE.

SEWAGE PURIFICATION IN AMERICA: A DESCRIPTION OF the Municipal Sewage Purification Plants in the United States and Canada. By M. N. Baker, Associate Editor *Engineering News*. With 79 Illustrations and an Index. New York: Engineering News Publishing Co. [Paper. 8vo, 196 p., $1.]

FORMERLY, owing to a lack of examples at home, when an American engineer wished to construct a sewage-purification plant, he was obliged to study foreign practice, either by going abroad or by consulting books. But within ten years past a number of sewage-purification plants have been built in this country, some of them unequaled by any abroad except in magnitude. In addition, the Massachusetts State Board of Health has contributed largely to the world's knowledge of the subject by its experiments at Lawrence, so that there now exists plenty of information on this subject near at hand. But until quite recently many of the American examples had not been described at all, while such descriptions as did exist were scattered through engineers' reports and engineering journals. This fact led the *Engineering News* to begin the publication of a series of articles based upon personal visits to various sewage-purification plants, with drawings and descriptions furnished by the designing or constructing engineers, or the officials in charge. These articles have been revised and reprinted in book-form.

This volume describes six intermittent filtration plants, eight plants employing chemical treatment, and fourteen that have tried broad irrigation, together with five others using different methods. The broad-irrigation class includes ten western localities, under the title, "The Use of Sewage for Irrigation in the West." These cities are in or near irrigation centers, and the sewage is used quite as much for the sake of moisture to the crops as for its fertilizing properties, although purification is generally the main object.

Perhaps the best-known works described are those located at Pullman, Ill., and South Framingham, Mass., where both irrigation and intermittent filtration have been practised, and at Worcester, Mass., and East Orange, N. J., where chemical precipitation is employed. At East Orange precipitation is supplemented by the application of the clarified sewage to grass land and to beds of gravel and cake. All the other chemical-precipitation plants rely wholly upon this one process, and South Framingham and Pullman are the only plants that combine irrigation with filtration. With scarcely an exception the author found the works he visited remarkably free from the objectionable features popularly ascribed to sewage-purification plants.

In general we may gather from this volume that intermittent filtration has proved highly successful in this country wherever it has been fairly tried, and that chemical precipitation has given very fair satisfaction, except where the process has been crippled by too great economy in the use of chemicals. The chemicals most used are lime, alum or sulphate of alumina, and peroxide of iron. Crops are seldom raised on intermittent filtration areas, and thus far sewage-farming, although broad irrigation is quite common, has not been carried on in a very scientific manner, western farmers using the sewage much as they

would water, merely to give moisture to their crops. The use of the sludge from chemical-precipitation works as a fertilizer seems to be growing in favor, but thus far the most that can be expected is that farmers will draw it away, if given to them. The severe winter climates of the north do not interfere with land disposal so much as would be expected. Altogether, the outlook for sewage-purification in this country is encouraging, and with the advance of popular sanitary knowledge the demand for a cessation of the contamination of water-supplies is rapidly increasing.

VENTILATION AND HEATING. By JOHN S. BILLINGS, A. M., M. D., LL. D., D. C. L., Member of the National Academy of Sciences, Surgeon United States Army, etc. New York: The Engineering Record, 1893. [Cloth. 8vo, 495 p., $6.]

THE art of ventilation is so intimately related to that of heating buildings that neither can be scientifically and adequately discussed by itself. In recent times good ventilation in all buildings is coming to be more and more regarded as an absolute essential to maintaining the highest standard of physical and mental vigor. It is true that people may live and study and work in comparatively ill-ventilated buildings for long periods without suddenly wrecking physical or mental health; but in the increasing struggle for subsistence and precedence in modern society the question each man or woman who has entered for the race has to answer is not merely how he or she can do *some* work, but how each can do the *best* work and attain to the *highest* plane of physical and mental vigor, so that the *most* of work, or of pleasure (work *and* pleasure, if the reader please), can be realized in the brief span of human effort. As truly as a nourishing digestible diet is needed to maintain healthful life, a plentiful supply of pure air for breathing and for displacement of exhaled impurities is needed in order that the human organism may work up to the full measure of its power.

A book that so plainly sets forth the true principles of ventilation that all intelligent, educated people who will take the trouble to read it may understand these principles; that not only points out the evils of deficient ventilation, but verifies them; that not only clearly states the requirements in apparatus for good ventilation, but also the difficulties to be met in securing such requirements, at the same time being so free from technicalities as to fit it for the use of lay readers without lessening its value for men technically trained,—is a welcome addition to the hitherto somewhat meager books upon ventilation. Such a book has been supplied by Dr. Billings, who has made ventilation a special study for many years. This author, while bringing to his work a rare scientific and educational equipment, possesses the happy faculty of writing in a popular style without thereby being betrayed into weakness and error in the enunciation of principles,—a faculty not frequently met in writers upon scientific subjects.

The ready understanding of the text in this book is assisted by 210 illustrations, including diagrams serving to make plain the construction and uses of various instruments and apparatus essential to the determination of direction and velocity of air-currents in inclosed spaces and flues, and the chemical analysis of air for ascertaining qualitatively and quantitatively the impurities in it. Copious and detailed illustrations of ventilating apparatus employed in important examples of practice in heating and ventilating private and public buildings are also given. The part of the work devoted to such description and illustration will prove of more value to architects and engineers than to lay readers. Some space is also devoted to ventilation of mines, ships, stables, barracks, etc. Under these headings may be found considerable matter, which, however, adding a little to what is now made part of regular instruction in schools of mining, will be of interest to those engaged in ventilating buildings by way of general information, rather than from new facts contributed to the common stock.

While as a whole this book is worthy of very high commendation, in both purpose and execution it does not speak with such

positiveness and authority upon some scientific and practical points relating to ventilation and heating that all its statements will be accepted without demur by heating and ventilating engineers and architects. For instance, the yet unsettled state of the questions whether upward or downward ventilation is to be always preferred, or whether, according to circumstances, either may be sometimes better than the other, or whether a combination of both may not, under certain conditions, be more advisable than either used singly, may be cited. In the discussion of this subject Dr. Billings rehearses the arguments in favor both of upward and downward ventilation, but adds little if anything of value to the discussion that was not already familiar to experts in heating and ventilation prior to the appearance of his present work. In fact, the reader, after perusing what is said of "inlets and outlets" in the eleventh chapter, and the general discussion on direction of flow in ventilation in the fifteenth, will probably get the impression that the author has not himself arrived at positive and definite conclusions upon this subject.

On page 132 the author criticises a habit of some engineers, in specifying ventilation, wherein they are wont to base calculations upon the number of times the air volume in a room to be ventilated is to be changed per hour, meaning by this the number of such volumes of pure air that shall be forced into and through the rooms. Now the basis of such a specification is rarely anything else than the number of cubic feet of fresh air, proposed to be supplied for the maximum number of people which it is assumed will occupy the room. When this is determined, there is no apparent objection to reducing it to terms of the volume of the space to be ventilated.

In some of the propositions made with more or less positiveness by the author, there appears to have been some want of due consideration. For example, on page 84, is found the sentence:

"*Pure air contains no stored force*, and cannot properly be called a food." The proposition contained in the italicized words will seem strange to a student of thermodynamics; and, unless they were intended to mean exactly what they say, it puzzles the mind to conceive either what idea is intended to be conveyed by this curious statement or the sequence of the unitalicized words to the first part of the sentence. The proposition that air contains no stored force is so inexact that it could scarcely have been written by a man of Dr. Billings's attainments except through an inadvertence. How are the tension of air, the work it performs while expanding, and its resistance to compression to be accounted for except by the fact that it has, at any temperature and pressure, a stored expansive force?

An attempt to find what is said on various topics treated in the volume through the aid of the index shows the latter to be far too incomplete for a work like this, which in the hands of professional men should become a valuable work of reference. For instance, while diffusion of impurities, as gaseous bodies, in air, is frequently mentioned in the book, one looks in vain for the word "diffusion" in the index. Dust is also frequently spoken of as important to be considered in relation to modes of ventilation, filtering air, etc., but in finding what is said about it the index affords no help. The defects of which these are a type are regretfully mentioned as samples of a kind of perfunctory work too frequently met with in indexes, particularly in American books.

LEICESTER ALLEN.

THE BIOGRAPHICAL DIRECTORY OF THE RAILWAY OFFICIALS of America. Edition of 1893. Edited and compiled by T. A. Busbey. Published biennially by The Railway Age and Northwestern Railroader. Chicago. [8vo, 418 p., $5.]

THIS is a very convenient and useful volume. Instances are constantly arising when information is needed in regard to the careers of prominent railroad men, as well as of men who have lately come into prominence in the railway world, and we all know how little is to be learned on the subject from the ordinary sources of information. A reference to this Directory answers every question that is likely to arise in the business office.

HENDRICKS' ARCHITECTS' AND BUILDERS' GUIDE AND Contractors' Directory of America. For the years 1893-94. Published annually by Samuel E. Hendricks Company, New York. [8vo, 650 p., $5.]

THIS Directory is the only complete work of its kind in existence. It is a complete directory of all the construction industries of the country, containing over 170,000 names, addresses, and business classifications, comprising builders and contractors of material and construction in the building and kindred industries. The list of American architects is complete and accurate, and no less accurate are the lists of architects in Canada, Cuba, and Mexico. There are also full lists of the manufacturers of, and dealers in, everything employed in the manufacture of material and apparatus used in the building industries, from the raw material to the manufactured article. There are over 800 separate classifications, and the system adopted is excellent.

ELECTRIC LIGHTING AND POWER DISTRIBUTION. An Elementary Manual for Students, etc. By W. Perren Maycock, M. I. E. E. Parts I, II, and III. Illustrated. New York: Macmillan & Co.

THE author of this work is a well-known teacher in the City and Guilds of London Institute, perhaps the most successful technical institution in England. Finding from experience that there was no satisfactory elementary text-book suitable for the instruction of beginners, Mr. Maycock has undertaken to supply the deficiency by the preparation of this treatise. The present edition is in three parts, and is in paper covers, but in a new edition the parts will be bound together in permanent form. A somewhat careful examination of Mr. Maycock's work justifies us in speaking of it in terms of almost unqualified commendation. Everything is made plain to the comprehension of the student; mathematical formulæ are introduced as sparingly as possible, but concrete numerical examples are used throughout in great abundance. The author mentions a very pretty "American" method of getting at either of the three fundamental equations of Ohm's law, which deserves to be better known than it is, viz.: "Write down the formula $\frac{E}{CR}$; place your finger over the quantity required, and it is equal to what remains." The whole subject of industrial electricity, with the exception of the electric railway, receives thorough consideration. Of course, the illustrative examples given are mainly of English and not of American practice, but the principles are alike in both, and this is the important thing.

ELECTRICITY UP TO DATE FOR LIGHT, POWER and Traction. By John B. Verity, M. Inst. E. E. New York: Frederick Warne & Co. [Cloth. 12mo., 163 p., 75 cents.]

THE fact that this little work has reached its third edition is an assurance that it is not wholly destitute of merit. Its contents are mainly of a popular character, but the explanations of electrical apparatus and processes are concise and clear, and call for little or no criticism from a technical point of view. We should be glad to feel assured of the final retirement of the venerable French engraving of the electric arc after its reappearance for the five-hundredth time, more or less, in this work, and the substitution of something more nearly representing modern conditions, but that is perhaps too much to hope for. The American electrician will find one thing of value in its pages not so conveniently presented elsewhere, so far as we know, and that is a statistical account of each of the electrical-supply companies now operating in London, with a colored map showing the geographical districts respectively allotted to each. A very good glossary of electrical terms is appended, together with a satisfactory index.

NEW BOOKS OF THE MONTH.

Allen, W. W. and Avery, R. B.=California Gold Book. First Nugget: its discovery and discoverer; account of the discovery of gold in 1848-49. Chicago: Donohue, Henneberry & Co. [49 pp.]

Brierley, A.=How to Become an Expert Book-keeper: a New System on the most Simple Principles for Self-Tuition. New York: Excelsior Publishing House. [32mo, 220 p., cl., 50 cts.; indexed, 75 cts.]

Calderón, Climaco, and Britton, Edward E.= Colombia. New York: Robert Sneider. [8vo, 122 p., paper, $1.]

Foote, Allen Ripley.=Prosperity and Politics. Washington: Kensington Publishing Co. [16mo, 187 p., paper, 50 cts.

Gresley, W. S.=Different Methods of Working Coal in Various Countries. Erie, Pa. [32mo, paper, 61 p.]

Haferkorn, H. E.=Handy Lists of Technical Literature. Reference catalogue of books printed in English from 1880 to 1888 inclusive; to which is added a select list of books printed before 1880 and still kept on publishers' and jobbers' lists. Parts 5 and 6, Fine Arts and architecture, painting, sculpture, decoration, ornament, carpentry, building and art industries, etc., include issues up to May, 1893, and a number of earlier books frequently met with in catalogues, with a list of periodicals and annuals in these branches. Milwaukee: H. E. Haferkorn. [4to, cloth, 664 p., $3.50.]

Hall, T. B.=The Infringement of Patents for Inventions, not Designs—with Late Reference to the Opinions of the Supreme Court of the United States. Cincinnati: Robert Clarke & Co. [275 p., 8vo, $5.]

Houston, Edwin J.=The Electric Transmission of Intelligence, and Other Advanced Primers of Electricity. New York: W. J. Johnston Co., Ltd. [8vo, 330 p., cloth, $1.]

Howells, W. D., Clemens, S. L., Shaler, N. S., and others.=The Niagara Book: A Complete Souvenir of Niagara Falls. Buffalo, N.Y.: Underhill & Nichols. [12mo, cloth, 230 p., $1.25; paper, 50 cts.]

Local Engineering Data for St. Louis. St. Louis: The Engineers' Club. [52 p., paper, 75 cts.]

Molesworth, Guilford L. and Robert B.= Pocket Book of Engineering Formulæ and Memoranda. New York: Spon and Chamberlain. [Leather, 815 p., $2.]

Munro, J.=The Romance of Electricity. New York: Fleming H. Revell Co. [8vo, cloth, 320 p., $2.]

Perkins, George A., and others.=Report of the Commission to Improve the Highways of the Commonwealth of Massachusetts. Boston: Wright and Potter. [8vo, cloth, 238 p., $1.]

Pomeroy, J. Norton.=A Treatise on the Law of Water-Rights, as the Same is Formulated and Applied in the Pacific States, Including the Doctrine of Appropriation and the Statutes and Decisions Relating to Irrigation. A revised and enlarged edition of "Pomeroy on Riparian Rights" with several additional chapters by H. Campbell Black. St. Paul: West Publishing Co. [8vo, 628 p., sheep, $5.25.]

Principles of Fitting for Apprentices and Students in Technical Schools. By a Foreman Pattern-maker. New York: Macmillan. [12mo, cloth, 323 p., $1.50.]

Rothwell, R. P.=Universal Bimetallism and International Monetary Clearing House. With a record of the world's money, statistics of gold and silver, etc. New York: Scientific Publishing Co. [8vo, cloth, 75 cts.]

Todd, Mrs. Marion.=Railways of Europe and America, or Government Ownership. With notes from official sources. Boston: Arena Publishing Co. [12mo, 288 p., cloth, $1.25.]

White, Gleeson.=Hand-book on the Preparation of Working Drawings. New York: Macmillan. [12mo, cloth, 327 p., $2.50.]

Wilson, Edward L.=Photographic Mosaics: An Annual Record of Photographic Progress. New York: Edward L. Wilson. [8vo, paper. 332 p.]

NEW TRADE CATALOGUES.

Any of these catalogues free on application to the manufacturers.

The Edward P. Allis Company, Milwaukee, Wis.=The Reliance Works and Some of Its Products. 50 p. [Views of important flour-mill, saw-mill, and engine-plants, equipped by this company, including some of the most important in the United States.]

The Hanson and Van Winkle Company, Newark, N. J.=Process of Electroplating by Bicycle-Power Plating Dynamo. 16 p. [A novel machine affording a reliable source of electrical energy suitable for deposition of metals on a smaller scale than has been convenient with the apparatus at hand.]

The Graves Elevator Company, Rochester, N. Y.=Elevators. 100 p. [Describing and illustrating every kind of elevator and many new devices for speed, safety, and economy.]

C. S. Knowles, Boston, Mass.=Material and Specialties for Electrical Purposes. 24 p. ["Tenax" rubber friction tape, "onyx" tape, "tenax" line tape, gas-fitter cement, hard rubber battery cells, rubber car springs, etc.]

Riehle Brothers Testing Machine Company. Philadelphia, Pa.=Illustrated Catalogue No. 3, 2 vols. 150 p. [Descriptions of testing machines, marble molding and countersinking machines, ball-bearing screw jacks, pig metal trucks, etc.]

Pittsburgh Locomotive Works, Pittsburgh, Pa.=Locomotives Exhibited at the World's Columbian Exposition. 50 p. [Eight wheeled passenger compound, ten wheeled passenger, mogul compound freight, ten wheeled freight, four wheeled saddle tank, etc.]

The Northwestern Terra-Cotta Company, Chicago, Ill.=Illustrated catalogue. 46 p. [Photographs of buildings recently erected partly or entirely of Terra-Cotta, and figured scale drawings of designs for which molds are kept in stock.]

Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa.=Transmission of Power. 79 p. [Description of systems and apparatus furnished by the company. Direct-current systems, the two-wire synchronous system, Tesla polyphase system, overhead lines, etc.]

Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa.=Illustrations of standard apparatus 58 p. [Direct current generator, current diverter, stage regulator, compensator, ground detector, etc.]

Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa.=Electric Railway apparatus. 60 p. [Motors, car-equipment, generators.]